Society

FOR THE

Promotion of Engineering Education

PROCEEDINGS

OF THE

TWENTY-SIXTH ANNUAL MEETING

HELD AT

NORTHWESTERN UNIVERSITY

EVANSTON, ILL.

JUNE 26–29, 1918

VOLUME XXVI

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1918

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John R. Wagner.....	1894....	January 21, 1899.	VII, 187
Francis A. Walker....	1896....	January 5, 1897.	VII, 188
G. D. Walters.....	1913..	November 5, 1916.	XXIV, 342
H. L. Watson.....	1914....	1917.	
Howard S. Webb.....	1897....	June 12, 1905.	XIV, 286
Nelson O. Whitney....	1893....	March 17, 1901.	IX, 339
James R. Willett.....	1896....	May 9, 1907.	XV, 679
De Volson Wood.....	1893....	June 27, 1897,	V, 325
Calvin M. Woodward...	1893....	January 12, 1914.	XXI, 437

GENERAL SUMMARY OF MEMBERSHIP.

MARCH 15, 1918.

Institutions Represented.

Colleges and Universities Teaching Engineering.

Domestic	159
Foreign	22
Manual, High, Correspondence and Trade Schools	32
Total Institutions	213
Institutional Members	66
Members	1440
Total Members	1506

GROWTH OF MEMBERSHIP.*

Aug.	20, 1894	156		
Sept.	2, 1895	184		
Aug.	20, 1896	200	(about)	
Aug.	16, 1897	203		
Aug.	18, 1898	226		
Aug.	17, 1899	238		
July	2, 1900	249		
June	29, 1901	261		
June	27, 1902	253		
July	1, 1903	271		
Sept.	1, 1904	325		
June	28, 1905	379		
July	2, 1906	400		
July	1, 1907	415		
June	27, 1908	675		
June	24, 1909	759		
June,	23, 1910	848		
June	27, 1911	1,071		
June	1912	1,102		
June,	1913	1,158		
March,	1914	1,291	Institutional members	48
July	1, 1915	1,403	Institutional members	49
March,	1916	1,447	Institutional members	57
March,	1917	1,447	Institutional members	58
March,	1918	1,440	Institutional members	66

* These figures are taken from the reports of the Secretary, presented at the annual meetings, except the figures for 1914 which were taken from the corresponding year book.

CONSTITUTION

OF THE

Society for the Promotion of Engineering Education

1. NAME—This organization shall be called the SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION.

2. MEMBERS—Membership in the Society shall be of two general classes, Institutional and Individual.

Institutional members shall be educational institutions giving instruction in engineering and scientific subjects.

Individual membership shall be of two classes, Active and Honorary. It shall comprise those persons who occupy or have occupied responsible positions in the work of engineering instruction, together with engineering practitioners and other persons interested in engineering education.

Honorary Members of the Society shall be such persons as may be recommended by unanimous vote of the Council after a letter ballot. In taking this ballot, the Secretary is directed to close the polls one month after the names of the candidates are sent out. Councilors not heard from will be counted in favor of the candidate. Honorary Members shall not have the right to vote, shall not be eligible to office, and shall not be required to pay any fees or dues.

Any individual member not in arrears for dues may become a Life Member by paying Fifty Dollars into the treasury of the Society at one time.

The name of each candidate for individual membership shall be proposed in writing to the Council by two members by whom he is personally known. In the case of a candidate for Institutional membership the name shall be proposed by any member familiar with the work of the institution on receipt of an application signed by a responsible officer thereof. Such name, if approved by the Council, shall be voted on by the Society at the annual meeting, a vote of three-fourths of those present being required to elect; or, during the period between annual meetings, an affirmative letter ballot of three-fourths of those members of the Council whose vote reaches the Secretary within one month from the time of sending out the name of the candidate shall elect. Such letter ballot elections shall be credited to the previous annual meeting and dues shall date from that time, except that elections to membership occurring after

February 1 shall be credited to the next annual meeting and the dues for the remainder of the year shall be one-half the annual dues.

3. OFFICERS—There shall be a President, two Vice-Presidents, a Secretary and a Treasurer, each to hold office for one year, or until their successors have been elected and have qualified. The Officers shall be elected by ballot of the Society at the annual meeting.

4. COUNCIL—The Council of the Society shall consist of twenty-one elective members, one-third of whom shall retire annually. The Officers and the Past Presidents of the Society shall be members of the Council ex-officio.

Any member of the Society shall be eligible to election to the Council, provided that not more than one elective member shall be from any one college.

Members of the Council shall be elected by ballot by the Society at its annual meeting.

The Council shall constitute a general executive body of the Society, pass on proposals for membership, elect candidates ad interim, attend to all business of the Society, receive and report on propositions for amendments to the constitution, and shall have power to fill temporary vacancies in the offices.

The President of the Society shall be Chairman of the Council, and the Secretary of the Society shall be Secretary of the Council and shall keep the minutes of its meetings and an accurate record of all its actions.

When votes taken by letter ballot of the Council shall be required, all votes which reach the Secretary within one month from the time of sending out the ballots shall be counted, but votes reaching the Secretary later than the time here specified shall not be counted.

5. NOMINATING COMMITTEE—The Nominating Committee shall consist of the Past Presidents and the seven elective members of the Council retiring the following year, provided, however, that if, of this committee, the number in attendance at any meeting be less than five, the President shall make appointments so as to form a committee of five.

6. FEES AND DUES—The admission fee for an individual, active member, which shall also include the first year's dues, shall be Four Dollars ($4.00), and the annual dues, which shall include the subscription price of the BULLETIN, provided for in Art. 8, shall be Four Dollars ($4.00), payable at the time of the annual meeting.

The admission fee for institutional members, which shall also include the first year's dues, shall be Ten Dollars ($10.00), and the annual dues, which shall include the subscription price of three copies of the BULLETIN, and of the PROCEEDINGS, provided for in Art. 8, shall be Ten Dollars ($10.00), payable at the time of the annual meeting.

The fiscal year shall end with the close (or adjournment) of the annual

meeting. Those in arrears more than one year shall not be entitled to vote, nor to receive copies of the PROCEEDINGS, and such members shall be notified thereof by the Secretary one month previous to the annual meeting. Any member who has been in arrears more than two years and duly notified by the Secretary, shall be dropped from the roll, until such arrearages are paid.

7. MEETINGS—There shall be an annual meeting at such time and place as the Society at the preceding annual meeting, or the Council may determine.

8. PUBLICATIONS—The publications of the Society shall include an annual volume of PROCEEDINGS, to be published and distributed to the membership as soon as possible after the annual meeting; and a monthly BULLETIN, to be published from September to June, inclusive.

9. AMENDMENTS—This Constitution may be amended by a two-thirds vote of those present at any regular meeting of the Society provided the amendment shall have been approved by the Council by letter ballot by a two-thirds vote of the members voting.

BY-LAWS OF THE SOCIETY AND RULES GOVERNING THE COUNCIL.

First. The Officers of the Society shall constitute a Committee to arrange for the annual meeting and to prepare a program for the same.

Second. The President, the Secretary and the Treasurer shall constitute an Executive Committee which shall have charge of all matters relating to the expenditure of money of the Society, the making of appropriations to Committees and for other purposes, the making of contracts, the approval of bills, and also during the period between the meetings of the Council shall have charge of other business affairs of the Society.

Third. Expenditures of money may be made only in accordance with a definite appropriation or by direct vote of the Executive Committee.

Fourth. Reading of papers shall be limited to fifteen minutes each or to such other time as may be designated by the Program Committee, and abstracts of papers of about three hundred words shall be printed when practicable, and distributed in advance to the members.

Fifth. The time occupied by each person in the discussion of any paper shall not exceed five minutes.

Sixth. The President, the Secretary and the retiring Secretary shall constitute a Publication Committee, of which the Secretary shall be Chairman, to edit and have charge of the publication of the monthly BULLETIN and the PROCEEDINGS of the Society, except the volume of Proceedings of the last convention, which shall be edited by the retiring

Secretary. If at any time there be no retiring Secretary the retiring President shall be a member of this Committee.

Seventh. The Officers, members of the Council and members of the local Convention Committee shall constitute a Committee on Sociability to introduce members and guests to each other at the annual meetings and in general to promote a spirit of good fellowship.

Eighth. The subscription price of the BULLETIN shall be Two Dollars per year, payable in advance.

Ninth. Additions or amendments may be made to these By-Laws at any regular meeting of the Society, on the recommendation of the Council by a two-thirds affirmative vote of the Council and of the Society.

PUBLICATIONS.

The publications of the Society can be obtained from the Secretary. The current issues are distributed gratuitously to members in good standing, one copy of each to each individual member and three to each institutional member. The price of the bound volumes of the PROCEEDINGS of former years is $2.50 to non-members, $2.00 to public libraries, and $1.50 to members for their own libraries.

The BULLETIN is issued monthly from September to June. The price to non-members is $2.00 per year. Libraries may order the BULLETIN and the PROCEEDINGS at $4.00 per year.

Reprints of papers may be ordered when the papers are in type form, and either with or without covers, at a price depending upon the number of pages and copies desired.

FINAL PROGRAM OF THE TWENTY-SIXTH ANNUAL MEETING, NORTHWESTERN UNIVERSITY, EVANSTON, ILL.

WEDNESDAY, JUNE 26, 1918.

11:30 A. M.—Meeting of Council.

2:00 P. M.—Opening Session.

President Ketchum presiding.

Address of Welcome: By Thomas Franklin Holgate, President, Northwestern University.

Response: By Milo S. Ketchum, President of the Society.

Address, "Engineering Education and the War." By J. R. Angell, representing the War Department.

Paper, "Some Present Day Problems in Engineering Education." By V. Karapetoff, Cornell University.

Paper, "The Effect of the War on Engineering Graduates and the Industries." By G. F. Pfeif, General Electric Company.

Report of Treasurer.

Appointment of Auditing Committee.

Report of Secretary.

Appointment of Committees on Resolutions and Nominations.

Announcements by Local Committee.

8:00 P. M.—Annual Mixer Meeting at Northwestern Gymnasium.

THURSDAY, JUNE 27.

9:00 A. M.—Meeting of Council.

9:30 A. M.—Business Session.

President Ketchum presiding.

Report of Joint Committee on Engineering Education, C. R. Mann.

Paper: "Students' Army Training Corps." By C. R. Mann, Chairman, Advisory Board, Committee on Education and Special Training, War Department.

12 M.—Luncheon.

2:00 P. M.

Addresses on the War and

The Bureau of Education, by S. P. Capen, Specialist.

The Federal Vocational Board, by C. A. Prosser, Director.

The Committee on Education and Special Training, by C. R. Dooley, Educational Director.

8:00 P. M.—Joint Meeting with the Western Society of Engineers and the Chicago Sections of the American Society of Mechanical Engineers, and American Institute of Electrical Engineers.

Subject: "Education and the War."

FRIDAY, JUNE 28.

9:00 A. M.—Meeting of Council.

9:30 A. M.—Business Meeting.

President Ketchum presiding.

Report of Committee No. 8, Admission, E. F. Coddington.

Report of Committee No. 9, Administration, Ira N. Hollis.

Report of Committee No. 12, English, C. W. Park.

Report of Committee No. 14, Economics, C. C. Williams.

Report of Committee No. 15, Civil Engineering, A. H. Fuller.

Report of Committee No. 16, Mechanical Engineering, O. A. Leutwiler.

Report of Committee No. 17, Electrical Engineering, C. F. Harding.

Report of Committee No. 18, Mining Engineering, F. W. Sperr.

Report of Committee No. 20, Standardization of Technical Nomenclature, J. T. Faig.

Report of Committee No. 21, Military Engineering, L. S. Randolph.

Report of Special War Committee, Milo S. Ketchum.

Friday afternoon has been set aside for an excursion by electric cars to the United States Naval Training Station at Great Lakes, Ill.

6:30 P. M.—Annual Dinner at Ravinia Park.

Presidential Address: "Essentials in Engineering Education." By President Milo S. Ketchum.

SATURDAY, JUNE 29.

9:00 A. M.—Meeting of Council.

9:30 A. M.—Business Session.

President Ketchum presiding.

Report of Committee on Resolutions.
Report of Committee on Nominations.
Election of Officers.
Paper: "War Training Activities at the Agricultural and Mechanical College of Texas." By J. C. Nagle.
Paper: "Engineering Degrees in the Latin American Republics." By H. W. King, University of Michigan.
Paper: "War Activities at the West Virginia University." By C. R. Jones.
Papers.

12:30 P. M.—Adjournment.

Directions for Reaching Headquarters.—Nearest elevated station, Noyes street; nearest railroad station is David street.

Registration and Information.—The place of registration and general information in connection with rooms, meals, baggage, etc., will be in one of the dormitory buildings. The general registration, post office, etc., will be in Swift Hall of Engineering.

Rooms.—Visiting members will room in the dormitories and fraternity houses which are beautifully located on the shores of Lake Michigan adjoining Swift Hall of Engineering, where the meetings will be held.

Meals.—Meals will be served in the dining rooms of certain fraternity houses.

Meeting Place.—All meetings of the Society will be held in the main lecture room, Swift Hall of Engineering. Meetings of the Council and all committees will be held in adjoining rooms.

Recreation and Excursions.—The Local Committee hopes that its guests will, as a rule, use the late afternoon hours to get acquainted with each other in the open air on the shore of the Lake and the Committee will endeavor to make it pleasant for them to do so. There will be opportunities for swimming and out-of-door activities. As indicated in the program, there will be an informal meeting at the Gymnasium on Wednesday evening, and both the afternoon and evening of Friday will be devoted to an excursion on the North Shore and a dinner at one of its most pleasant resorts, Ravinia Park.

General Committee.—Director John F. Hayford, Chairman, H. S. Philbrick, O. H. Basquin, W. C. Bauer.

Committee on Rooms and Meals.—H. S. Philbrick, Chairman, W. C. Bauer, W. F. Bryan, K. K. Smith.

Committee on Relations with Non-Members and Entertainment of Visiting Ladies.—O. H. Basquin, Chairman, H. S. Philbrick, W. S. Bryan.

Committee on Arrangement at Swift's Hall of Engineering.—John F. Hayford, Chairman, W. H. Burger, K. K. Smith, M. R. Hammer.

Committee on Afternoon Excursions and Other Social Affairs.—W. C. Bauer, Chairman, W. H. Burger, K. K. Smith.

Officers for Northwestern Meeting.—Milo S. Ketchum, President; John F. Hayford, Ira N. Hollis, Vice-Presidents; F. L. Bishop, Secretary; W. O. Wiley, Treasurer.

MINUTES OF THE TWENTY-SIXTH ANNUAL MEETING.

NORTHWESTERN UNIVERSITY, EVANSTON, ILL.,
JUNE 26–29, 1918.

The twenty-sixth annual meeting of the Society for the Promotion of Engineering Education was held at Northwestern University, Evanston, Ill., June 26–29, 1918. The sessions were held in the main lecture room of the Swift Hall of Engineering.

MINUTES OF THE REGULAR SESSIONS.

WEDNESDAY, JUNE 26.

Opening Session.

The meeting was called to order at 2:00 P. M. by Vice-President John F. Hayford in the absence of President Milo S. Ketchum, who was unable to leave his duties in connection with the construction of the explosives plant for the government at Nitro, W. Va. In the absence of President T. F. Holgate, acting President of Northwestern University, U. S. Grant, dean of the College of Liberal Arts, delivered the address of welcome. Past-President William T. Magruder responded for the Society.

J. R. Angell, representing the War Department, delivered an address on "Engineering Education and the War." Dis-

cussion. Professor V. Karapetoff's paper, "Some Present-Day Problems in Engineering Education," was read by title. Mr. G. F. Pfeif read a paper on "The Effect of the War on Engineering Graduates and the Industries." Discussion.

The Treasurer's report was read and upon motion referred to an auditing committee. The report of the Secretary was read and upon motion accepted with the thanks of the Society. The Committee on Resolutions was appointed and consisted of the following: R. L. Sackett, J. D. Phillips and L. M. Hoskins. The Committee on Nominations was also appointed and consisted of Ira O. Baker, G. C. Anthony, H. S. Jacoby, W. T. Magruder, L. M. Hoskins, Chas. S. Howe, T. U. Taylor, W. E. Mott.

THURSDAY, JUNE 27.

Morning Session.

The meeting was called to order with Vice-President Hayford in the chair. The report of the Joint Committee on Engineering Education was read by Dr. C. R. Mann. Discussion.

Afternoon Session.

Lieut. B. O. Wills delivered an address on "The Needs of the Navy." Dr. C. R. Mann read his paper on "Students' Army Training Corps." Discussion. The paper, "The War and the Bureau of Education," was read by Dr. S. P. Capen. Mr. C. R. Dooley not being present his paper, "The War and the Committee on Education and Special Training," was read by title. Discussion.

FRIDAY, JUNE 28.

Morning Session.

The meeting was called to order with Vice-President Hayford in the chair. The Nominating Committee reported as follows:

For President: John F. Hayford, Northwestern University.

For First Vice-President: J. T. Faig, Ohio Mechanics Institute.

For Second Vice-President: E. R. Maurer, University of Wisconsin.

For Secretary: F. L. Bishop, University of Pittsburgh.

For Treasurer: Wm. O. Wiley, 432 Fourth Avenue, New York, N. Y.

For members of the Council to serve for three years: Frederic Bass, University of Minnesota; C. F. Harding, Purdue University; O. A. Leutwiler, University of Illinois; C. R. Mann, Massachusetts Institute of Technology; J. R. Nelson, University of Michigan; F. L. Pryor, Stevens Institute of Technology; and W. J. Risley, James Millikin University.

On motion the Secretary was instructed to cast the unanimous vote of the Society in favor of all of the above candidates.

A paper, "Some Suggestions for Consideration," by F. H. Newell was read. Discussion. The institutional delegates reported having sent the following telegram to Secretary of War Newton D. Baker:

"The institutional delegates present at the convention of the Society for the Promotion of Engineering Education express their hearty appreciation of the cordial relations which have existed between the engineering schools and the Committee on Education and Special Training of the War Department and offer their sincere coöperation in support of plans for the Student Army Training Corps."

The motion of the Council that it recommend to the Society that the Society recommend to the United Engineering Societies that the subject of research as suggested by Professor Karapetoff be presented to them for action as they see fit was presented and upon motion carried. W. J. Risley delivered an address on "Training Teachers for Certain Branches of Military Training." The report of Committee No. 12, English, was read by J. R. Nelson. Discussion. The

report of the Special Committee on Economics was read by the Secretary and adopted. The Committee was discharged with the thanks of the Society. The report of Committee No. 15, Civil Engineering, was presented by A. H. Fuller. Upon the suggestion of Professor Jacoby the discussion of this report is to be sent to the Secretary in writing. The report of Committee No. 17, Electrical Engineering, was presented by C. F. Harding. The report of Committee No. 20, Standardization of Technical Nomenclature, was presented by J. T. Faig.

Saturday, June 29.

The meeting was called to order with Vice-President Hayford in the chair. J. C. Nagle presented his paper, "War Activities at the Agricultural and Mechanical College of Texas." In the absence of C. R. Jones, his paper, "War Activities at the West Virginia University," was read by title. The Committee on Engineering Degrees presented its report. Discussion. H. W. King delivered an address on "Engineering Degrees in the Latin American Republics." The Committee on Resolutions presented the following resolutions, which were adopted by the Society:

"The twenty-sixth annual meeting of the Society for the Promotion of Engineering Education has been made peculiarly pleasant and companionable through the fine hospitality provided by Northwestern University. Therefore, be it

"Resolved, That the appreciation of the Society be expressed to the President of Northwestern University, the Director of the College of Engineering, the Faculty members of the efficient committees which arranged for our entertainment and for the various trips. We thank the ladies of the faculty for the delightful hospitality extended to members and their guests.

"The Society wishes to express its obligations to Captain Moffett, of the Great Lakes Training Station; to the officials

of the Sanitary Canal and of the Evanston Waterworks for courtesies extended on the inspection trips."

The Committee on Mathematics, No. 10, recommended that the Society through its executive officers request the coöperation of the Mathematical Association of America toward the appointment of a joint committee for consideration of and report upon the entire question of teaching of mathematics, the members of this committee to be appointed by the executive officers of both organizations acting jointly. The Committee further recommends that the present committee be discharged.

Moved, seconded and carried that the Committee on Committees appoint a special committee to consider the report of the Joint Committee on Engineering Education and make a report to this Society.

The meeting adjourned *sine die*.

MINUTES OF COUNCIL MEETINGS.

Meetings of the Council were held on June 26 and 27. Members who attended these sessions were: Gardner C. Anthony, Ira O. Baker, F. L. Bishop, Thomas E. French, John F. Hayford, L. M. Hoskins, Charles S. Howe, Henry S. Jacoby, E. J. McCaustland, Wm. T. Magruder, William E. Mott, T. U. Taylor, and W. O. Wiley.

The motions passed were as follows:

1. That the year book in its general form be omitted.

2. That due to the absence of President Milo S. Ketchum, Vice-President John F. Hayford read the presidential address as prepared by President Ketchum at the annual dinner and the copies distributed after the reading.

3. That the Council recommend to the Society that it recommend to the United Engineering Societies that the subject of a committee on research as suggested by Professor Vladimir Karapetoff be called to their attention for consideration for such action as they see fit.

4. That the next meeting be held in a place near Washing-

ton but not in it. The matter of meeting place to be decided by letter ballot.

The following applicants were recommended to the Society for election: R. K. Strong, F. A. Vaughn, A. M. Winslow, The Doherty Training Schools, and the Ohio Mechanics Institute.

The following budget of income and expense for the coming year was reported by the Executive Committee and adopted by the Council:

ESTIMATED RECEIPTS.

From back dues	$1,000	
From current dues (individual)	4,800	
From current dues (institutional)	670	
From advertising	850	
From sale of publications	200	$7,520

ESTIMATED EXPENSES.

A. Northwestern meeting, 1918	$ 300	
B. Proceedings:		
Printing, paper, comp., press work, binding, packing, alterations, mailing, drawing and engraving	1,100	
C. ENGINEERING EDUCATION:		
Printing, paper, comp., press work, alterations, author's and editor's, mailing, drawing and engraving	1,350	
D. Committee expenses	150	
E. Treasurer's honorarium	300	
F. Secretary's honorarium	1,000	
H. Clerical assistance	1,200	
I. Sundry printing	200	
J. Postage and expressage	300	
K. Telephone and telegraph	50	
L. Office supplies	125	6,075
Estimated Surplus		$1,445

COUNCIL LETTER BALLOTS TAKEN DURING 1917–18.

August 1, 1917.—Leon E. Dix and the University of Cincinnati (2).

November 19, 1917.—Henry H. Armsby, Carroll D. Billmyer, John G. Callan, T. Pryor Campbell, Harold H. Dunn, Carl S. Ell, M. W. Furr, Robert G. Griswold, Carl A. Groetzinger, Edward C. Jones, Phillip B. McDonald, Russell B. Nesbitt, Robert H. Owens, Oscar A. Randolph, Daniel V. Terrell, William D. Turnbull, Samuel Ward, Camillo Weiss (18).

December 21, 1917.—F. G. Baender, Cecil F. Baker, Samuel P. Capen, Jasper O. Draffin, Willard H. Eller, Paul E. Holmes, Leon B. Howe, Benjamin Kamrass, Victor V. Mavity, S. O. Miller, Rexford Newcomb, Oscar W. Sjogren, Lenix C. Sleesman, J. E. Smith, Ralph D. Whitmore (15).

February 7, 1918.—Alfred D. Cole, L. D. Crain, Harold N. Cummings, Ross C. Durst, Leroy S. Foltz, Clifton R. Hill, Sandy M. Kane, J. Earl Krotzer, Raymond Mathews, Charles A. Tonsor, Jr., J. Herman Wharton (12).

February 19, 1918.—W. H. Avram, J. S. Bikle, C. P. Eldred, A. A. Hall, E. E. McAdams, C. C. Martinson, G. B. Pegram, F. G. Person, G. H. Pfeif, A. W. Prine, Wm. J. Putnam, L. W. Whitehead (12).

March 11, 1918.—Frederic C. Blake, Earl L. Consoliver, Carl H. Knoettge, Carl A. Norman, William S. Perry, Theodore R. Running, Samuel D. Sarason, Embert H. Sprague, Charles A. Styer, John A. Voskamp, Walter G. Ward, Warren Weaver, Jay W. Woodrow (13).

April 2, 1918.—Franklin H. Ayres, Arthur B. Coates, David L. Snader (3).

May 24, 1918.—Norman J. Dicks, William E. Duckering, Arthur G. Gehrig, David A. Hatch, H. K. Humphrey, Otto L. Kowalke and the Massachusetts Institute of Technology (7).

TREASURER'S REPORT.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, JUNE 21, 1918

Trading Account.

6/21/17	*Dr.*		
Inventory		$3,193.55	
Cost of publications		3,162.23	
Cost of Black's Address		320.52	
		$6,676.30	
Less inventory		2,675.70	
Cost of sales			$4,000.60
			$4,000.60
	Cr.		
Sale of publications		$350.33	
Sale of Black's address		198.16	
¼ of members' dues		1,334.00	
3/10 of Institutional dues		197.25	$2,079.74
Advertising		936.50	
Less discount		10.18	926.32
			$3,006.06
Balance—profit and loss account. Loss			994.54
			4,000.60
			$4,000.60

Profit and Loss Account.

	Dr.		
Balance—Trading account			$994.54
Annual meeting—1917		$472.35	
Committee expenses		159.25	
Treasurer's honorarium		304.30	
Secretary's honorarium		1,000.00	
Secretary's clerical assistant		1,020.00	
Postage and express		334.54	
Telephone and telegraph		118.08	
Office supplies		130.21	$3,538.73
			$4,533.27
	Cr.		
Dues—Individual		$4,001.65	
Dues—Institutional		460.25	
Exchange		.44	
Interest on deposit		12.18	$4,474.52
Balance—Loss for year			58.75
			$4,533.27

Balance Sheet.

Assets.

Accounts receivable:		
Individual:		
Current dues	$1,459.00	
Back dues	2,119.72	
Institutional:		
Current dues	95.00	
Back dues	67.50	
Members and Non-members	428.37	
Secretary's office	38.94	$4,208.53
Cash:		
Lincoln Trust Co.	$1,139.72	
Life membership fund	397.20	
Secretary's office	150.00	1,686.92
Inventory		2,675.70
		$8,571.15

Liabilities and Surplus.

Accounts payable:		
Members paid in advance	$137.71	
Secretary	550.00	
New Era Ptg. Co.	3,121.55	$3,809.26
Surplus	$4,423.44	
Less—loss for year	58.75	4,364.69
Life membership		397.20
		$8,571.15

MEETING OF INSTITUTIONAL DELEGATES.

At a meeting of the institutional delegates on Friday, June 28, the following resolution was adopted and the Secretary instructed to telegraph it to the Secretary of War, Newton D. Baker:

HONORABLE NEWTON D. BAKER, *Secretary of War,*

War Department, Washington, D. C.

The institutional delegates present at the convention of the Society for the Promotion of Engineering Education express their hearty appreciation of the cordial relations which have existed between the engineering schools and the Committee

on Education and Special Training of the War Department and offer their sincere coöperation in support of plans for the Student Army Training Corps.

(Signed) F. L. BISHOP, *Secretary.*

The following reply was received under date of July 18:

DEAN F. L. BISHOP,
University of Pittsburgh,
Pittsburgh, Pa.

Convey to delegates at convention of Society for the Promotion of Engineering Education hearty thanks for their resolution transmitted in your wire of June twenty-eighth. The Committee on Education and Special Training will greatly value continued advice and coöperation from your organization.

(Signed) NEWTON D. BAKER.

REPORT OF SECRETARY FOR 1917–18.

The Secretary has endeavored to carry on the work of his office more energetically than in previous years because he believes that the promoting of engineering education is at the present time one of the important ways in which the government can be served. The routine work has been carried on as usual. I will not take your time to discuss that.

Members.—At the end of the fiscal year ending June 30, 1918, there were 1,511 members, 67 institutional. One year ago there were 1,521 members, 63 institutional. During the present year 10 members have died; 30 have been dropped for non-payment of dues; and 66 have resigned. A letter was sent to each member of the Society, asking his coöperation in securing new members. About 1,500 names were submitted and three letters were sent to each. As a result 79 new members were added to the rolls. The Executive Committee recommended on the fourteenth of August that members enlisting in the Army or Navy and whose duties kept them away from their respective colleges or universities be held on the rolls of the Society without sending them bills

for dues until their return to their school duties. The Secretary has received notices of 95 members of the Society who have entered the service of the country; 68 of these coming under the ruling.

The Secretary has coöperated with the Treasurer. Three letters and bills were sent from the Secretary's office to those owing $8.00 or over.

Professor L. H. Harris, who has been Assistant Secretary since 1914–15, was called into active service in the Engineers' Reserve in August. Upon recommendation of the Secretary, the Executive Committee decided that the Secretary should not appoint an assistant secretary for the present year but increase the clerical assistant in the office of the Secretary from $900 to $1,100 per year.

War Activities of the Society.—Many suggestions in regard to the work which this Society could do to help win the war were received and considered at the Washington meeting. Out of this grew the suggestion that Dr. Godfrey as chairman of the institutional delegates and a member of the Advisory Commission of the Council of National Defense, appoint a committee of the Council of National Defense of five members to be known as the Committee on Engineering Education of the Council of National Defense. This committee took action on August 7 looking to the deferred classification of engineering students. This matter was kept constantly before the Secretary of War through the assistance of Dean F. P. Keppel, now Third Assistant Secretary of War. Meanwhile various members of the Society were working on this matter. It was deemed advisable to have President Ketchum appoint a Special War Committee to consider this matter. As a result of these activities on December 11 the Provost Marshal issued the following regulations:

"Under such regulations as the Chief of Engineers may prescribe a proportion of the students pursuing an engineering course in one of the approved technical engineering schools listed in the War Department as named by the school faculty, may enlist in the Enlisted Reserve Corps of the En-

gineer Department and thereafter, upon presentation by the registrant to his local board of a certificate of enlistment, such certificate shall be filed with his questionnaire and the registrant shall be placed in Class V. on the ground that he is in the military service of the United States."

The success of the engineers in securing consideration for engineering students led the Association of American Colleges at the Chicago meeting to consideration of the same subject. Shortly after this meeting a conference was called in Washington of men representing the various organizations and this Society was represented at that meeting by the Secretary. Out of this grew the Emergency Council on Education with headquarters in Washington. President Ketchum appointed the Secretary to represent this Society in that work.

The Committee on Engineering Education of the Council of National Defense recommended to the Secretary of War that an organization be provided within the War Department to have control of technical training and education. This recommendation was eventually adopted by the Secretary of War and there was organized in the War Department the present Committee on Education and Special Training.

The individual members of this Society have engaged in many phases of war work. At the same time many have devoted their energies to developing the relation of engineering education to the war and the preparation of young men for service during and after the war. There was never a time in the history of the country when there were so many important questions confronting engineering education.

ADDRESS OF WELCOME.

BY U. S. GRANT,

Dean, College of Liberal Arts, Northwestern University.

Mr. Chairman, Members of the Society for the Promotion of Engineering Education, and Ladies:

I know President Holgate regrets very much indeed that he cannot be with you today to welcome you here. I regret that myself fully as much as he, and I hope the regret will not be entirely mutual on your part. We cannot all do just what we want to do and when we want in these times; if that were so, I think many of us would be three thousand miles farther east.

The City of Evanston and Northwestern University are proud to welcome this Society at its meeting for the summer of 1918. Evanston is a small city of some thirty-five thousand people, which has grown upon the shore of Lake Michigan, not necessarily around, but with, Northwestern University. Those of us who live here feel that the town is one of education and culture, not the "k" kind of kultur, however, and we hope that you who are here will go away feeling that it is also a city of hospitality.

I might say here, however, that a State law which we have had for many years makes Evanston a dry town. From my acquaintance locally with engineers, I know that is a drawback to the city, and I assure you it is dry; you cannot find certain things even in the clubs. I notice the committee has drawn your attention in the program to the bathing facilities and I hope you will be satisfied with that.

Northwestern University was founded in 1851 and began operations within a very short time after that, so that for nearly seventy years there has been a University in this local-

ity. As most infant and new institutions in the West, it started simply with the College of Liberal Arts, in fact, I think it started more with a preparatory school than with a college, as was customary in those times. During its growth it has acquired, however, sometimes by joining forces with other institutions, and sometimes by actual new educational ventures, a number of professional other schools, so that now we have about nine distinct schools or colleges. On this campus which is some seventy-five acres in extent and lies along the shore of the lake, are the College of Liberal Arts, the Graduate School, the School of Music, the School of Oratory and the College of Engineering. In the city of Chicago are the professional schools, law, commerce, dentistry and medicine, so you do not have a chance to see at this place all of the activities of the university. Our summer school is not in session, so, with the exception of students attending the summer surveying course of the College of Engineering, you will see few students. We do, however, present a rather active appearance during actual college time.

It may be of interest to you to know that the institution has grown from very small beginnings, and that during the last three years we have had between four and five thousand students each year. This year, as many other institutions have done, we have found that our numbers have decreased, but the number is still above four thousand.

The College of Engineering was organized in 1907 and began its work in 1909. It is built on the plan of a five-year course which attempts to give in the first four years the fundamental training and sciences of a college education. At the end of the fourth year the students attain the degree of Bachelor of Science. I shall not touch on what may be said later or on what you may already know, regarding the College of Engineering.

May I repeat that Northwestern University welcomes you here. We are yours and we hope you will use us for the few days you are here. We hope also that the delightfully cool

weather we have had for the last few days will continue, although frankly, Chicago is famous for all kinds of weather in very short intervals. I hope your stay in Evanston will be pleasant and that you and we will profit by it. If we can help you and aid you, I am sure you will let us know and we shall do the very best possible.

RESPONSE TO ADDRESS OF WELCOME.

BY WILLIAM T. MAGRUDER,

Past President.

Fellow-Members of the Society and Ladies: The enforced absence of President Ketchum puts me at a rather sudden disadvantage, and doubly so since Director Hayford has been pleased to advance me from the rank of a plain counsellor to the rank of a vice-president!

In behalf of the Society I desire to thank Dean Grant and the Northwestern University for his cordial words of welcome and for this most delightful weather. Evidently you and the Weather Bureau have come close together lately and one has controlled the other so that the latter has promised to give us most delightful weather; and now that we are not to have a dry town, but a real wet one with all Lake Michigan at our back, I suppose we may expect all sorts of things other than rain; but if we are to indulge in too much of Lake Michigan water, I hope the director of the School of Engineering will see that it is sanitary.

This meeting, gentlemen, recalls to my mind the first meeting of our Society and the time when it was formed and founded here in Chicago at the time of the World's Fair, in 1893. We are returning to the Chicago district to celebrate twenty-five years of continuous life and usefulness.

I want to congratulate Northwestern University for taking Dean Hayford and putting him into a position where he can practice what he taught some of us at the Cornell meeting twelve years ago.

At that meeting, as some of us will remember, he read a paper on "Why not teach about men—the most difficult tool an engineer uses." I have quoted that paper time and again.

Now we are here and have been welcomed to the center where he and Dean Grant and the faculty of this engineering school will show us exactly how he teaches about men—the most difficult tool an engineer uses.

In behalf of the Society, I again thank Dean Grant for his cordial words of welcome. I know we shall enjoy this full and extensive program and also the large number of excursions that have been planned for us.

INTRODUCTION TO PRESIDENTIAL ADDRESS.

BY VICE PRESIDENT JOHN F. HAYFORD.

About a year ago I happened to be in a group of about a dozen men at a noonday luncheon in Washington. The discussion during the luncheon had been in regard to the necessity of speed in the preparations made for war by our Allies, the necessary speed which we must show, and especially the speed which must be developed in the United States.

Toward the end of that discussion my next neighbor who happened to be a French officer and who had seen service at the front, practically summarized the discussion by this one statement:

"You have a saying in your country" (meaning the United States) "that time is money. That is ordinarily true, but," he said, "now time is blood."

President Ketchum happens to have been for many months assistant director of an explosives plant being built and put into operation at Nitro, West Virginia. The plant is being very rapidly developed and increased in size. They have seventeen thousand men there at present and their force is increasing. Of course, as assistant director in such a group, if he realizes that time is blood, which happens to be literally true, and that if we slow up in our preparations there comes an unnecessary loss of hundreds of lives, he knows he must remain where he is. Therefore, under those circumstances, I honor him for responding to what he recognizes as the greater call and staying in West Virginia rather than coming to Evanston.

I feel just as he does about it; therefore, I feel that I am doing but little if I try to help him in his work here by putting back of his address,—which has been carefully prepared

and is before me,—the little additional punch that comes from your hearing it as the spoken word, rather than reading it for the first time from the printed page.

That is why I appear before you very gladly and willingly to deliver his speech. I am glad to do my part in that way because I find myself very much in sympathy with what he has written. I would be glad to claim it as my speech.

ESSENTIALS IN ENGINEERING EDUCATION.

BY MILO S. KETCHUM,

President, Society for Promotion of Engineering Education.

Engineers and engineering schools have taken a very important part in war activities and have shown the value of technical training. Under the changed conditions due to the war all educational methods and ideals should receive careful scrutiny to see whether or not they fill the needs of the hour. In this brief address the essentials in engineering education will be briefly considered.

Before starting to build a machine or a structure the engineer prepares plans and specifications. If we are to prepare to educate an engineer, we should also have specifications for the finished product. A well-known engineer has given the following definition of a good engineer: "A good engineer must be of inflexible integrity, sober, truthful, accurate, resolute, discreet, of cool and sound judgment, must have command of his temper, must have courage to resist and repel attempts at intimidation, a firmness that is proof against solicitation, flattery or improper bias of any kind, must take an interest in his work, must be energetic, quick to decide, prompt to act, must be fair and impartial as a judge on the bench, must have experience in his work and in dealing with men, which implies some maturity of years, must have business habits and knowledge of accounts. Men who combine these qualities are not to be picked up every day. Still they can be found. But they are greatly in demand, and when found, they are worth their price; rather they are beyond price, and their value can not be estimated by dollars." (Chief Engineer Starling's Report to Mississippi River Commission.) Stated somewhat differently, an engineer must

have general training, must have technical training, must have professional experience, must have high moral character, must have a knowledge of men, must have a broad vision, must have administrative and business experience.

While all will agree as to the specifications and requirements of a good engineer, a careful study of the curricula of engineering schools will show that there is a great difference of opinion as to what are the essentials in engineering education in order that students may be given the proper training so that they may, after obtaining sufficient practical experience, become engineers. A brief discussion of the essentials of engineering education by an engineering educator who has for some months been engaged in engineering administration may be of value.

In the beginning it should be remembered the problem is not only to train the student so that after sufficient experience he may become an engineer, but also to make a man out of a boy. The latter is even more important than the former; and every scheme of education must keep in mind the fact that clean living and straight thinking are the essentials of all educational methods. Students come to college from high schools with very different degrees of preparation, varying from the boy from a well-to-do family who has graduated from an English or classical high school to the boy from a workingman's family who has had just sufficient training in a poor high school to enable him to enter. While schools with private endowments may select applicants for admission by a rigid examination, most state universities find it necessary to admit by credentials and then give the freshman a full term in which to show his ability.

The most critical time in the engineering student's career is during the first semester when he is making the change from a high-school student to a college freshman. The freshman has no appreciation of his new duties and responsibilities and requires very careful direction if he is to make the best use of his opportunities. Freshman teachers should be men

of mature experience, selected for their ability to interest and enthuse students as well as for their teaching ability. If young teachers must be placed in charge of freshmen they should be engineering graduates selected with reference to their ability to interest and enthuse students. In this connection it should be kept in mind that the harshest judge is always one who has been the shortest time on the bench, and also that the teacher who has but recently graduated is usually too critical of the abilities of others and too proud of his recently acquired knowledge to be placed in charge of freshmen classes.

The courses of engineering schools contain little or no engineering subjects during the first two years, and it is difficult to keep up the student's interest. It has been suggested that the student's interest be aroused by the addition during the first two years of properly selected elementary professional subjects. In the University of Colorado the teachers in mathematics, drawing and English are engineering graduates who have had sufficient engineering experience to be able to show the freshmen and sophomores the direct application of their courses to engineering practice. The instructors in mathematics are not only able to teach mathematics, but know from experience the value of mathematics to the engineer. The student immediately feels that mathematics is not something to be gotten by, but is to be a tool that will help him to solve many knotty problems. The instructor in engineering English has had a large experience in technical writing, and is not only able to teach the students to write, but knows from experience the value of English to the engineer. The success of the departments of engineering mathematics and engineering English, with engineers as teachers, is merely an example of the well-recognized fact that the prime essential for a successful teacher is to know his subject. What right, then, have we to expect a teacher of mathematics or of English who has studied mathematics or English merely to teach others to

teach, to successfully teach engineering students who are interested in doing things?

An engineer requires training in pure science so that he may be able to apply scientific laws and principles to the solution of engineering problems, and also in order that he may make researches for himself. It is more important that he be given basic courses in science that will open up the field and that will teach him to use scientific methods in taking up a new line of work, than that he be given extended courses going into the technique of the subject and including a large number of experiments.

Mathematics should be taught concretely and not abstractly. The principal difficulty with students and engineers is to express observed facts and data in mathematical terms preliminary to the mathematical solution of the problem. The student should be taught that mathematics is merely a mill into which data are fed to be turned into a form that will be useful to the engineer. He should also be taught that mathematics and mechanics will never take the place of judgment, but are useful in making experience already gained applicable to new conditions, and also that no mathematical process can give results that are any more accurate than are the data upon which the calculations are based. The student should be given training in graphic calculation in order that he may be able to visualize the problem, and thus prepare the data for the mathematical process. Many problems that are very difficult when solved by algebraic processes are very simple if solved by graphics. Teachers of mathematics in high schools and liberal arts colleges, as a rule, have had no training in graphics, and therefore do not use graphics in mathematical instruction. Many students who have shown very little ability to understand algebraic processes are able to understand the same problems when solved by graphics. The engineer should be able to use algebraic or graphic methods with equal facility. By properly choosing the method, it is possible to save a large amount of time in calculations, or one

method may be used in making the original calculations and the second method may be used for check solutions.

Many problems in mechanics that are very difficult to solve by algebraic methods are very easily solved by graphics. The calculation of stresses in a continuous beam of variable cross-section, which is a very difficult problem when solved by algebraic methods, is a very simple problem when solved by graphics. The details of this solution are so simple that they may be understood by a freshman of average ability. Graphic methods are capable of as great accuracy as are algebraic methods, and at the same time, are less liable to large accidental errors or mistakes.

All measurements and data used by the engineer in his calculations are approximate values and the results of calculations are therefore at the best only probable values. There is therefore no subject of mathematics that is of more value to the engineer than that of the theory of probability. The theory of probability has been defined as that line of mathematical reasoning by which one is able to determine by scientific methods a result that would be arrived at by one who has had a very large experience and trained judgment. Many of the laws of mechanics may be derived by applying the laws of the theory of probability, which fact shows the direct connection between mechanics and the theory of probability.

Drawing and surveying should be taught to develop the student rather than to make draftsmen or surveyors. In teaching surveying, better results are obtained by the men working in squads than in large parties, as is the custom in actual pracice. The assigned problems should be designed with the idea of developing the theory of surveying instruments and their application rather than with the end in view of making a surveyor.

In the beginning of engineering schools, the curriculum consisted mainly of languages, mathematics, chemistry, and physics, together with surveying and brief courses in engineering construction. Engineering teachers were for the

most part men with little or no engineering experience, and as a result the training in the engineering school did not prove to be of any material benefit aside from the libert arts training. The engineering graduate was not looked on with favor, either by the financial man who employed him, or the practical engineer under whom he worked. There was a constant conflict between engineering theory and engineering practice.

With the advance in pure and applied science, the curriculum of the engineering school has changed from an inferior liberal arts course with a smattering of engineering practice, to a course in applied science with a close and intimate contact with the latest advances in engineering practice. Engineering schools now have fully equipped laboratories in which commercial tests are made of materials and machines. Many engineering teachers have made notable additions to scientific knowledge as applied to engineering construction. The feeling of antagonism between practical engineering and theoretical engineering has disappeared, and engineers and technical schools are now working in very close coöperation. Engineering contractors find that they must needs keep in touch with the laboratory if they are to solve present-day construction problems. The most approved and latest advances in mechanics together with properties of materials are now recognized as essential to engineering construction. There is no longer any conflict between engineering theory and engineering practice. It is now universally recognized that a satisfactory design can only be evolved after all of the theoretical and practical considerations have been taken into account. The engineer is no longer satisfied with rule-of-thumb methods, which were the basis of the art of engineering. The engineering teacher is no longer looked upon as an interesting specimen that must be tolerated and endured, but is now given an honorable position in the engineering profession.

An engineer is a man who not only designs and builds safely, but who designs and constructs a structure or machine

that is adapted to the needs, with a cost commensurate with the service rendered. The design of a structure requires not only the knowledge of the properties of materials and the ability to calculate the stresses, but also a knowledge of local conditions and requirements, of economical design, of details of construction, of methods of erection, methods of fabrication, and their effect on cost, and many other matters which limit the design. The most economical structure for any given conditions is the one which will give the greatest service for the least money, quality of service and life of the structure being given the proper consideration. Financial limitations often limit the design and the problem then is to design a structure that will give satisfactory service with the money available.

To design a satisfactory structure when limited by financial considerations is a problem that requires the exercise of the highest possible skill on the part of the engineer. He must be able to select an economical type of structure; he must make an accurate estimate of the loads to be carried by the structure; he must be able to calculate the stresses with accuracy; he must make the details of the design with due reference to ease of obtaining the material, to cost of shop work, and cost of erection.

The successful engineering contractor must be trained not only in applied science but in business methods and in addition have some familiarity with the law. He must not only be able to build well, but must have the initiative to work out any problems in a way that will bring satisfactory results to both his client and to himself.

The successful engineer must not only have a thorough engineering training, but he must be trained to know men. The engineer must not only know how to design or to build, but must be able to impress others with his ability. In administrative positions, the ability to select subordinates is a prime essential. More engineers fail in administrative positions due to their inability to select men than due to any other one

thing. As a class, engineers are prone to judge men too much on their technical ability alone, and give too little attention to those qualifications and characteristics in men that make it possible to use technical knowledge. A man with a disagreeable disposition ordinarily has no opportunity to use his technical ability except in a very inferior position. One of the most important advantages gained from technical education is contact with other men and an appreciation of the value of human engineering. Of all the materials with which an engineer has to deal there is no material so difficult to handle and control as human material.

In addition to the usual courses in mathematics, mechanics, science and languages, the engineering course should include training, either formally or informally, in ethics and in a man's relations to his fellows. A well-balanced engineering course must not only give training in technical and humanizing subjects, but must give training in straight, logical thinking. The engineering student must be impressed with the idea that in the end he must appeal to the good sense and intellect of his hearer if he is to be able to put his plans into execution.

Methods of teaching students in the class-room and the laboratory are directly applicable to engineering construction. The inspector on concrete construction should instruct the foremen and workmen so that they will understand the effect of a poorly graded aggregate, the effect of too much water, and other details that determine the quality of concrete, rather than undertake to control the work by the force of his authority. The improved methods of construction proposed by the engineer must stand the criticism of the superintendent or the foremen if they are to be effective. A large engineering project is in effect a large engineering school in which the engineer and his assistants are the faculty, the superintendents and foremen are their assistants, and the workmen are the students. The more effective the work of the teacher and his assistants, the better will be the results. Where the

workmen as well as the foremen are kept interested in the work, the results are sure to be satisfactory. Interested workmen means efficient workmen. On large construction projects the organization is necessarily so complicated that the workman is easily lost sight of. If workmen are to be efficient, they must be well housed and well fed, and be given adequate opportunities for recreation. The workmen must have sanitary quarters and be given adequate medical attention. The success of engineering construction depends so much upon the character and quality of the service rendered by the workmen, that the engineer in responsible charge should have had considerable training and experience along the line of welfare work and sanitation.

With small construction jobs, it was possible for the superintendent with a limited personnel to accomplish satisfactory results without organization through his own personality. With large engineering projects, where the work must be completed in a very short time, the problem is a very difficult one. The main error in the organization of very large projects is that the administrative machinery is gathered together very rapidly without proper coördination. The problem of harmonizing the different elements in an organization of this character and working it into a single unit is one that appeals especially to an engineering administrator. The problem is one of education and not one in which the results can be obtained by exerting authority. The administrator should have absolute authority in order that he may not find it necessary to use the authority.

The results accomplished in military training camps show that educational methods have been very wasteful and inefficient. The idea that the student's initiative can be developed by turning him loose in the laboratory, the drawing room or the field to work out the problem without instructions is no longer tenable. No man has a right to have initiative until he has knowledge. If the student is taught to think straight

and that all work must be planned in advance, he will in due time develop initiative.

The efficiency of engineering education can be greatly increased by the use of proper pedagogical methods. The subject-matter of each course should be selected with the idea of developing the subject in a logical manner. The course should be developed with full notes and definite instructions for all experiments or problems. The most direct method in learning is to study a similar problem that is fully worked out, or to follow a problem survey that is fully worked out with notes or calculations. The use of sample problems, field notes or laboratory experiments, not only assists the student in learning the particular matter in hand, but gives him training in keeping his notes in an orderly manner and shows him that the best results from subordinates can only be obtained when they are given very carefully prepared and definite instructions.

The problems assigned to students should not be too complex or too complicated, but each problem should be selected to bring out and illustrate a few or even one important principle. Better results in teaching topographic surveying can be obtained by giving the student a series of field problems illustrating the different divisions of a survey, than to have the student assist in a large topographic survey where he has only a limited responsibility. All problems or exercises should as far as possible require that the entire solution be carried through by each student independently. The old saying that "a boy is a boy, two boys is a half a boy, and three boys is no boy at all" is almost literally true when applied to students.

In all calculations, experiments and field work great care should be used to impress the student with the great importance of the use of consistent accuracy. The student should be shown that all data which the engineer uses are approximate, and that the results of his calculations are therefore only probable values. He should be shown where he may use

a slide rule, where he should use five-place logarithms, and where seven-place logarithms. It will also be useful to show that six-place logarithms require more work in their use than do five-place logarithms with no gain in accuracy. The student should also be taught to use the different calculating machines. While the slide rule is a very useful tool its constant use by the student is open to question, for the reason that he does not get adequate training in performing ordinary arithmetical calculations. The engineer should be able to run hurriedly over calculations performing all arithmetical operations by short cuts or approximate methods, in order that he may be certain that the result is consistent. A common error with students and young engineers is to point off incorrectly, or to work out the details of one column of a tower and then forget to multiply by four.

In teaching engineering design it is very important that the student be given careful instructions. The size of the sheet and the scale of the drawing should be selected so that satisfactory results may be obtained. The time occupied in preparing a drawing of a particular machine or structure varies almost directly as the area of the drawing. Careful tests have shown that in teaching structural design a size of plate of 18 inches by 24 inches is much more economical of the student's time than a plate 24 inches by 36 inches. It should also be noted that the scale of the drawing on the smaller plate is seven tenths of the scale of the drawing on the larger plate. There is an additional saving of time in finishing drawings in pencil. By the use of drawing plates 18 inches by 24 inches in place of plates 24 inches by 36 inches, and by finishing drawings in pencil, the work in structural design in a given course may easily be doubled. While the recent graduate should have some familiarity with tracing, it is very much more important that he be able to make a good pencil drawing.

The student should be given an opportunity to get a familiarity with good literature so that he may in time become a well-read man. This may be done by regular courses or

by means of supplementary reading courses. The idea that certain courses were humanistic and therefore liberal, and that other courses were materialistic and therefore not giving a liberal training is no longer tenable. The humanizing and liberalizing value of any subject is in the teacher and is not in the subject. The most important part of any institution of learning is the teacher. The engineering teacher should be a man that will fill the specifications prepared by Engineer Starling in his report to the Mississippi River Commission, and in addition he should have teaching experience and a love for his work. While teachers of this type are worth the price, it is at present very difficult to obtain sufficient funds to keep able teachers from going into practice.

The most critical problem in engineering education to-day is to obtain a sufficient number of competent teachers. The Society can undertake no greater task than to improve the conditions and increase the emoluments of engineering teachers so that engineering students may all have instruction under men of thorough training in theory and practice who can comply with the specifications for a good engineer.

SOME PHASES OF THE WORK OF THE WAR DEPARTMENT, COMMITTEE ON EDUCATION AND SPECIAL LEARNING.

BY J. R. ANGELL,

Committee on Education and Special Training.

You doubtless know that the old army which we set out with in the beginning of the war had no formal provisions on a large scale for the maintenance of its enlisted expert corps. It simply trusted to incidental recruiting; if it needed a cook or a chauffeur, it went out and enlisted a cook or a chauffeur or trained some promising recruit. When we got the new army going, that plan, of course, went flat on its back. It was impossible to secure in that fashion the necessary number of carpenters, mechanics, cooks and chauffeurs. When the figures were gotten together, it was found that we required between three and four hundred thousand technical experts. You can get these men in three ways.

1. You can go to the industries and pick them out. That plan may wreck the industries and is particularly likely to hurt the essential war industries.

2. You can take the man after he comes into the army, and if he has had any kind of practical experience, you can give him special training. This plan has been widely employed. But it does not produce the necessary numbers.

3. You can set up schools for training new men and put them in the army after they have been trained to do special work. That is what the Committee on Education and Special Training is doing today and what I am to tell you about.

The army has been levying upon the civil institutions of the country to furnish the necessary equipment in instructors and apparatus and overhead arrangements of all kinds to train

100,000 technicians in short intensive courses. The actual work has been directed by the army committee already mentioned on which the General Staff, the Provost Marshal General and Adjutant General are represented. An advisory civilian board of which I happen to be a member gives such assistance as it can.

We have districted the country, have appointed district inspectors with a director at Washington and have made arrangements with one hundred and thirty-seven civil institutions for taking care of the men to be trained. We have just turned out the first ten thousand of those men.

A contract has been made with each institution for the maintenance and feeding of the men. The institution agrees to give instruction to a unit in gas engine work, gunsmith work, carpenter work, or this, that and the other thing. Expert instructors are gotten, the men are turned in on an eight-hour day to work six days in the week, and are drilled for a time daily besides. At the end of six or eight weeks we get what nobody could have predicted and what has been proven now to the extent of the ten thousand that I spoke of. You get the men who already have the rudiments of military drill, and some familiarity with life in a cantonment; and on top of that the men are really able technicians in one or another of numerous expert occupations which the army needs.

That in a nutshell is the thing which has been going on for the past three months and which is going on today with increasing magnitude and speed, for we are taking on more institutions.

This program is going to make not only an enormous difference in the efficiency and rapidity of equipping the army, but I venture to say that it will leave a dent in our educational methods long after the war is over. It constitutes on a scale which has never been approached in this country an educational experiment which is fundamentally significant for industrial education. So far as I can find out there has never been any attempt to take mature, intelligent, picked

men and to give them short intensive courses covering the whole day under the direction of skilful expert teachers, with a motive behind the job which called out the very best there was in the man. Men who are familiar with industrial training as it has existed in this country before, are almost to a man absolutely astonished at the outcome. Nobody could have predicted that in eight weeks you could train a bench carpenter, beginning with nothing but ordinary brains and a good pair of hands, to be so competent as actual experience recently has shown.

There are two or three other features of our work which I might comment on very briefly. The civilian end of this committee has been made up to represent as well as it might the several educational interests which are obviously immediately involved in this type of education. There was originally a representative from the engineering schools, a representative of the National Bureau of Education, a representative of the Federal Vocational Education Board, a representative of the Corporation Schools and a representative of the universities and colleges. Later on there were added representatives of the Land Grant colleges and of the labor interests. Doubtless the personnel will be still further increased as time goes on.

In solving our problem we might have relied simply on the staff corps schools to produce our results, training chauffeurs, and gas engine repair men, aëroplane mechanics, carpenters, and so forth; but had we relied on them we should have had to set up either in one great central school, or in a number of cantonments, all the equipment and overhead which goes to the equipping of good modern shops. The expense of that plan was absolutely prohibitive and the time consumed in putting an equipment—assuming what is improbable, in that it could have been procured—would have put us back another six months at least. But with these civil institutions offering their equipment and competent instructors, and giving us the most cordial coöperation, it has been possible to get this project going inside of a month, at a fraction of the expense

it would have involved to distribute the men in army schools all over the country.

There is another piece of work our committee has in hand which I had hoped I might be able to say something about today. It concerns the engineering reserve. Our plan has not actually yet received final approval and I am therefore not able to say anything about it in detail.

I shall be very glad to try and answer any questions, if I have suggested some that you would like to put. I cannot promise, of course, to be able to do so successfully, but I will answer those I can.

DISCUSSION.

H. S. Evans: I would like to ask Dean Angell why he referred to the six-weeks term, as we are using eight weeks in our institution. I would also like to ask him if he would be kind enough to tell us something of the work which these men are put into and what their expectations are at the end of their period of training.

J. R. Angell: I said six weeks because our original plans contemplated six or eight weeks. Six happened to come to my mind. As to the second question, that is very important and it is one which has caused a great deal of difficulty. The general plan has been to send the trained men to the staff corps school where they can be taken in and familiarized with the particular work of the corps. Take, for example, the motor truck transportation service—there is a great school of that sort under the Quartermaster Department in Florida. The men are being sent down there for that particular thing. When the machinery is well oiled, the men will be sent directly from the institutions to the particular locations where their special kind of training is required.

R. L. Sackett: I would like to ask Dean Angell if there are steps under way by which the men who are sent for training are to be selected further than they have been. We are wasting considerable time and energy in attempting to train men

for electrical lines whose educational preparation is wholly insufficient. In addition all of us have experienced the difficulty of taking men who had no practical training and I assume that is inevitable. In some lines we at least are striking almost impossible problems, because the men have not the capacity necessary for pursuing effectively the particular line for which they are sent.

Dean Angell: The first calls which the local boards responded to were sent out by the Provost Marshal with the qualifications in terms of a grammar-school education only. That was at variance with the wishes of certain of the committee who desired to have a higher level set and who desired a much more definite filtration process. But it was thought wise.

The method which we have before us at the present time to meet exactly your point is this: We are proposing to establish two or more concentration camps to which the men will be sent directly from the local boards for all the medical examinations and so forth, and during that time we hope to be able to sort them out; so if we catch in our drag of 5,000 men, for example, a group who are fit for your particular type of work, we will sort them out and send them to you.

I should like, if I may, to make this additional comment on Mr. Sackett's statement. It is true that in a few of the more expert lines the difficulty he speaks of has been very serious. Also, there have probably been few groups in which there have not been some who have proved themselves quite incapable of training, and they have had to be rejected even for the simpler types of work. That difficulty is a very real one and one the committee has been trying to face. On the other hand the general results have been astonishingly good.

T. U. Taylor: I should like to ask whether it is contemplated or not that these one hundred and thirty-seven schools will continue the course right along through the next session.

Dean Angell: We have drawn our contracts for only six and eight weeks at a time, because on the first experiment we

couldn't predict the outcome. We have in many instances renewed the contracts to clear through the autumn. If the war shows no signs of ending, we shall probably be very glad to make longer contracts with the most efficient institutions.

Dean Taylor: You referred to having 100,000 trained in a certain time.

Dean Angell: Yes, probably by the end of November.

Dean Taylor: That doesn't contemplate that will furnish all you need, does it?

Dean Angell: Not at all! That is roughly the unit needed for the size of the army as set by the War Department when we began our work.

F. L. Bishop: I would like to ask Dean Angell a question in regard to the corps schools. I understand some of these men have been sent to corps schools. Are those schools inspected?

Dean Angell: They are supposed to be; they have their own inspectors.

Dean Bishop: A rather interesting thing came to my attention. One young man was sent to one of these corps schools from a high school and when he reported he was given instructions that when he went to a classroom and there was no teacher present, he was to give the instruction himself, and he has been giving instruction ever since.

A letter came to a member of the faculty in connection with our institution a couple of days ago from the man in charge of one of the big corps schools who had taken the course under this member of the faculty in a Y. M. C. A. some few years ago. He said, "I am the chief instructor here and I am teaching these men, and I have had no experience except what you have taught me. Can you send me some questions and answers that I can give these men?" Is that typical of these corps schools?

Dean Angell: I don't want to tell tales out of school. I had rather have some representative of the army organization answer that question. I believe the fact is that the corps

schools are not all in a satisfactory position, but they are fighting hard to win. The experience cited, I fancy, is an exception.

W. T. Magruder: I would like to ask Dean Angell who selects these men and decides what branch of industry they shall follow in these schools? Who decides that I shall go into an electrical school and my brother shall become a carpenter, and so forth?

Dean Angell: The local boards are asked to supply the men, and, so far as possible, to consult the men as to any preference they have. Sometimes they have definite preferences. Many of them have not. If, after they get into the service, it proves they are already competent mechanics, there will naturally be no thought of turning them into anything but the mechanical trades. A man, of course, has some chance to influence his own fate.

Professor Magruder: Is there any machinery for taking care of misfits?

If I should desire to become President of the United States, would they consider it?

Dean Angell: Have you ever sat on these local boards?

Professor Magruder: I have not.

Dean Angell: Have you ever met with them?

Professor Magruder: Some of them.

Dean Angell: Then you will probably be able to answer that yourself. Some of them are extremely intelligent; some of them are not. Many of them have done admirable work; others we know are open to improvement.

J. H. Felgar: I would like to ask how we may go about getting what the Government contemplates in the outline of courses, for instance, for general mechanics or for wireless operators and the like.

Dean Angell: That work is being done as fast as we can get to it. The only material we had to start with was that prepared by the Vocational Education Board, and we finally found we couldn't use it. We are getting material together

as rapidly as we can. We are much farther ahead in some things than in others.

Dean Bishop: Does this committee, Dean Angell, contemplate taking control of the reserves such as the Engineers Enlisted Reserve, and if so, what relations will that bear to retention of instructors in schools of engineering?

Dean Angell: That is the matter I can't talk to you authoritatively about. Mr. Mann, when he gets here, I think can tell you.

The general project involves a scheme for enlisting every college boy who is physically fit from the years eighteen to twenty-one, making him an enlisted man in the army, furloughing him back into the college until he has completed his education or has come to the age where the selective draft law will get him. The student engineers corps will be absorbed into this general plan. They will cease to be independent units and will become part of the general college reserve, and the essential instructors along with them.

Dean Bishop: May I inject another question? What effect will that have on the R. O. T. C.?

Dean Angell: That is one of the problems that has been dropped temporarily.

Dean Taylor: Do I understand the plan is to enlist all engineers between eighteen and twenty-one?

Dean Angell: Not necessarily engineers—every college student.

Dean Taylor: Does that have any regard as to their grading class?

Dean Angell: Not as the plans are now drawn.

Dean Taylor: Does that apply to all colleges?

Dean Angell: Yes, if they wish to come in.

Professor Magruder: Irrespective of the physical fitness?

Dean Angell: No; I stated that, I think.

In the course of the discussion one sentence has been running frequently in my mind. I asked a man who ought to be posted on that particular part of the war work recently if

they would find anything when it was investigated that was poorly done. He said, "Sure, if we had gone ahead so slowly that we made no mistakes, we would have been going too slowly." I take it that what we had to do in this matter was to go ahead first and improve the methods afterwards. Anyone with much of a touch on Washington knows that is one of the things that had to be considered.

SOME PRESENT-DAY PROBLEMS IN ENGINEERING EDUCATION.

BY V. KARAPETOFF,

Professor of Electrical Engineering, Cornell University.

First Alternative.

Continuing the same curriculum and the same methods of instruction as before.

Looking towards greater specialization, depth and thoroughness, preparing men to contribute to real technical and scientific progress in the engineering art.

Continuing to teach auxiliary sciences in the usual way, that is, training the student in the use of abstract calculus, physical laws and chemical properties long before he needs this knowledge in his engineering studies.

Second Alternative.

Making changes—(*a*) to satisfy the immediate industrial and military needs. (*b*) With a view to reconstruction after the war. (*c*) As a readjustment long contemplated before and to be taken advantage of now due to small classes and a depleted faculty.

Broadening the course to prepare engineers for executive and managerial work, for sales, and for taking part in public life.

Starting engineering subjects in the freshman year, and explaining the necessary mathematical relations and physical and chemical laws in application to the specific practical problems on hand. Systematic treatment of calculus, physics, mechanics and chemistry reserved for the

Insisting upon purely individual mental effort and the ability to absorb certain prescribed information and to pass set examinations. School as preparation for life.	Emphasizing initiative, originality, power of analysis, the ability to select the method of attack, to orient oneself in a new situation, to get information needed and to organize at least a few classmates into an efficient team. School as life itself.
The same academic degree for brilliant and mediocre students.	First class degree for the better students, and a second class degree for those who have had marks not much above the passing grade. Or else, a competitive system according to which the lower ten per cent. of the graduating class receive second class degrees.
Instruction planned to give specific practical information and to prepare men to take subordinate positions in industry without much extra training, even at a risk of impeding their future advancement. A progress curve of negative curvature, that is, one that rapidly rises at first and then flattens out.	Instruction planned primarily to lay the foundation for maximum development of personality and greatest achievement throughout life; maximum adaptability to new conditions and a thorough grounding in the methods of attacking new problems. A progress curve of positive curvature.
Recitations in numerous small sections and plenty of	Most of the work done by means of lectures and discus-

last two years of the curriculum. ("Concentric Method of Education," see PROCEEDINGS of this Society, Vol. XVI (1908), p. 258.)

laboratory and drafting-room work. Most of the work done under younger instructors, the students being held strictly to a great amount of routine work, and required to hand in reports and pass quizzes frequently. Little personal contact with mature teachers and therefore but little personal influence and inspiration, but a good training in regular habits of work.

Prescribed courses for everyone, without regard to natural inclinations or desires. Everyone studies the same subjects in the same way and duplicates everyone else's effort, without much enthusiasm. A goosestep method of marching in a nature-study excursion. Functional specialization after graduation.

Students wasting summers in play or working at menial occupations that have nothing to do with one's chosen profession.

sions with mature professors. No machinery is provided for enforcing home-work, day after day, and the students cram for examinations. They carry away with them an entirely different kind of training than those taught in recitation courses, and the question is which method is more conducive to prepare leaders in thought and action, and which is better for a young man of only average ability and not much strength of character.

Learning from a successful animal trainer who first observes an animal and then selects for it, in so far as possible, the tricks that it naturally wants or likes to perform. An excursion in an unconstrained natural formation with different functions selected by individual men. Functional specialization in school.

Technical education as a state or federal function, properly coördinated, so that summers are either spent in practical work carefully laid out in the chosen branch of engineering, or else college instruction is continued

Weak or lazy students (also self-supporting students) who did not pass one or more important subjects during a term are hopelessly overloaded the next term on account of the full regular schedule and the back work besides, and in many cases fall back still further.

Students who fail in a major portion of their term's work are usually dropped and in most cases have to stay out for a term. When they come back they have lost the habit of study, have forgotten the proceeding subjects, and on account of having passed a few subjects before, have an irregular schedule.

Young healthy men getting their physical training in stuffy gymnasiums or watching games, while hired help is shoveling snow, mowing college lawns and doing repair and construction work.

Mature teachers overthroughout the year, with only brief periods for rest.

As soon as the student shows in his first year that the regular schedule is too much for him, the amount of his work to be reduced and he be required to graduate later than his classmates. Instead of overloading poor students, their load should be cut down to a point at which they can carry their work satisfactorily. It is the duty of large colleges to provide special schedules of courses for such slow men.

No student should be allowed to stay away from the school for a term, because of unsatisfactory work. If he cannot be given the courses that he needs he must be required to take other courses of similar nature to keep his mental life on the alert and to exercise his reasoning powers in the branches in which he is weak.

The upkeep of the college grounds and buildings as the first duty of the student body. Each student, poor or rich, to do his part according to a carefully laid out schedule, as a training in civic duties.

Responsible teachers re-

loaded with routine duties and rated on the basis of student-hours per week, like factory hands, in the name of efficiency. Older men who are allowed to become stale, who do not know much beyond the scope of the prescribed text book, and whose literary and scientific output and productive scholarship are equal to zero year after year.

Younger instructors overloaded with so much teaching work that they find no time or strength left for advancement in their chosen work, and become drudges long before the true limit of their ability has been reached. Teachers without thorough training in the fundamentals who cannot adequately or interestingly explain to students the real difficulties, who cannot read advanced books and who fail in every bit of research they undertake.

lieved of routine duties such as reading of numerous laboratory reports or examination papers, but expected to give the college the benefit of their mature judgment, to be accessible to the willing students for personal instruction and advice, to keep abreast of the progress of the art and to be productive investigators. Their usefulness to be measured primarily by the inspiration imparted to their graduates, and by the ability to maintain an atmosphere of scientific interest and a "school of thought" among the instructors and advanced students.

Young instructors carefully looked after by the older men in the department, guided in the principles of sound teaching and helped in straightening out their fundamentals and started on a systematic study of the subject, or on some piece of research. Instructors who do not show sufficient desire or aptitude for advanced study or research to be dropped after the second year so as not to arouse false hopes in them. Occasionally splendid instructors in elementary sub-

Military organization of the instructing staff from the president down, leaving but little room for initiative and academic freedom. The difficulty of finding a dean who himself is an acknowledged authority in some branch of science or engineering, and at the same time is a capable tactful administrator, a man of magnetic personality, and not a mere "gang boss." The same difficulty applies to the head of each department. The deadening and discouraging effect of administrators "with vim and vigor" upon true scholars and independent original thinkers. Advantages of a strict organization for elementary instruction.

jects are found who are incapable of mental advancement, but it is hardly fair to promote them to a professorial grade, because of the expectations which this grade carries in the eyes of the outsiders. A non-academic administrative grade, such as "superintendent," should be provided for such men.

A functional organization of specialists in each college and in each department. An elective dean and an elective administrative secretary in each department, in place of appointed heads. Specialists in student management, in elementary teaching, in theory, in engineering practice, in filling teaching positions, in the guidance of instructors, in research, etc., to be treated on an equal footing as such, and their ability fully utilized irrespective of their academic standing. Dangers in the lack of discipline and accountability on the part of the teachers to the men elected by themselves for a short term of years. The possibility of a doubleheaded organization with a scholastic head side by side with an administrative head.

UNITED STATES EMPLOYMENT SERVICE.

BY A. H. KROME,

United States Employment Service, Chicago.

Mr. Chairman, Ladies and Gentlemen: I assure you that this talk will be very short; I am not here to sell anything. This Red Cross tag indicates that I have been buying. I am here principally to explain the work of the United States Employment Service as it relates to engineering, and I think it is very necessary that the members of this Society become acquainted with the original plans of this service so that you can coöperate with the department in any way you can, during the war, and in connection with the registration that will be necessary to meet conditions after the war.

Of course, you are more or less familiar with the work that has been done with the United States Public Service Reserve which was organized under the Department of Labor some time ago and which has acted as a recruiting office for technical help. The Reserve has done very good work and has helped particularly in the eastern part of the country in placing many technical men in government positions.

Similar active agency has been operated by the national engineering societies and now by the Engineering Council, known as the American Engineering Service. This organization has placed many men in prominent engineering positions with the government, but we have found through different experiences that it is necessary to go into a more comprehensive study to meet the coming demands for technical service.

Recent estimates show that there are four positions today for every technical man available. If this is true, what will be the condition in six months from now? To meet these conditions a very careful study is necessary to get farther into

the problem of properly distributing the technical service that is available and meeting the greater demands.

The conditions before us will not permit lack of organization, planning, or loss of time. Ways and means of meeting the conditions, an immediate survey, along with actual service, filling positions that come to us; these are necessary. At first, we will have to depend upon volunteers who come along and whom you can refer to us to do something to meet the government's demands. By campaigning you get many volunteers from industry who will come forth, in a patriotic spirit, to help the government. At the same time, these very men may be needed in industry more than in the positions they will take, so that there is special need for a study along that line.

The Department of Labor has created the United States Employment Service and has developed several different divisions successfully for two or three years for the employment of common labor.

In connection with the war there have been several divisions established for farm labor, for skilled mechanics, and for women. For some time they have operated a teachers' division; in the teachers' section they handle free employment of teachers for the common schools, the high schools and all of the professional schools, and they have already handled and helped, in several cases, in getting teachers for the engineering schools.

Now comes a new division, the division of engineering, which has been started within the last two weeks. Possibly one of the direct causes for the establishment of this division was the poor practice on the part of the private employment agencies that were using ways and means of getting engineering positions listed for the government. These would advertise and correspond patriotically for technical men to fill those positions and then they would demand enormous cash fees in advance for that service. This was practiced so much that the government had to investigate and take hold of the service themselves, so that you may hear various rumors as to the

advisability of a technical engineering employment service under the division of labor. It may be referred to in different ways, but I appeal to each and every one as individuals, as well as to this Society, to support this division, to support the department, because it is not a question whether it is financed under the Department of Labor or under some special bureau created and established; it is a branch of the government. It has been established to give immediate service first to the government and then to the industries supporting the war business and then to any industry that may need engineers or technical men.

I feel as though you will be interested in a few of the ways and means which we are planning to establish to get the registration that is necessary.

You may know that through direct channels of engineering societies there are about fifty thousand maximum technical men that can be reached. It is easily estimated that there is another one hundred and fifty thousand, and possibly more, who are in the United States scattered in the various industrial centers. We have no direct channel to reach these men.

In making the industrial survey, we plan to work in close coöperation with the chambers of commerce and with the War Industries Board, to go down to the employers and seek their coöperation; to have them furnish a list of the technical men they employ. In this way, we will get the first accurate census as to the number of technical men and we will find from them, at the same time, how much short they are of the men they need.

As Dr. Mann was saying the other evening, one of the very greatest needs now is to find out how the demand and supply of technical men really stands. Rumor is going from one extreme to the other and a real census is possibly the only way by which we are going to be able to answer the question.

If the societies can give us, and we would appreciate it as soon as possible, any better suggestion of getting or securing that information, we can certainly use it to advantage. So far, by investigation we find nothing better than the indus-

try and the employers of the engineers themselves. Thousands and thousands of them are not graduates; they have come into engineering by private study and by practice, whether they are leading engineers or consulting engineers or what not, they are necessary in this time to meet the demand.

The real underlying point which was discussed today for hours at a conference of engineers was a comprehensive simple definition for an engineer and also definitions for draftsmen and other technical men who are not engineers. This is another place where we will ask for any help you can give. The definitions, as submitted, are in the hands of a special committee of engineers and it may be interesting to many of you to try to give one comprehensive definition that will cover the technical engineer.

The classification that will follow the registration we take from the industrial survey will be carried on by competent engineering committees and the government will have paid examiners who will possibly do the greater part of the detail work, but the matter of passing upon the training and experience of the various individuals after their complete records have been secured in the various regional districts will necesesarily be done by competent engineers who are able to pass on the men. This is another place where we will undoubtedly need volunteers from the various universities and from the members of this Society.

It is all a great work and you gentlemen have possibly studied more about the whole question than I have. You have been face to face with the problems as to the supply of engineers during the war and the general engineering conditions during times of peace.

It may be that one of the greatest by-products of the war will be a complete census and a complete registration of the technical men we have in this country.

My only appeal to this body is that you give us wholehearted support in this movement and help us supply the country during the time of war and help us find the real bottom for professional engineering service.

THE COMMONWEALTH EDISON COMPANY'S PLAN FOR RECRUITING ENGINEERS.

BY W. L. ABBOTT,

Chief Operating Engineer.

The Commonwealth Edison Company, like all other large employing companies, is beginning to be greatly concerned regarding several things which are the outgrowth of the war. Among other things are the scarcity of labor and the scarcity of engineers.

We have, for a number of years, been resorting to artificial means to maintain a sufficient quota of young engineers for our company. In the good old days, the young man from an engineering college would be hired for two dollars a day and put to work in the gang. If he stayed for any length of time, it was not because of any attention we had given him. For a time engineering graduates gladly came to us on these terms, but later on, we noticed they did not come so eagerly as they formerly did, and those we got would stay only so long as they were being given interesting work in which they were learning something. This scarcity of engineers, or their reluctance to come to us, was a progressive feature, noticeable at first with men from eastern universities and technical schools and gradually extending to the men from the universities of the central West. After graduates from these two localities began to find better employment elsewhere, we still got a supply from universities in the South and from those west of the Mississippi River. These men we trained for positions as switchboard operators in power houses and sub-stations, which positions they were glad to take, when other technical men would not consider them, but finally, when men from these last-mentioned sources were getting scarce, and we realized we were no longer getting the best material, our

company in connection with some other public-service companies started an educational department, which we called "The Central Station Institute." This institute was a combination of a post-graduate course with a system of practical training in the various departments of the companies. Originally it was intended to secure and train young men for positions as sales engineers and business solicitors. In an eleven-months course, they were given a few weeks experience in each of several departments of the company and finally were located in the contract department to learn the details of the work required of them there and developed into salesmen. Later this program was enlarged so as to include the training of men for the engineering and operating departments. Half of each day was spent in the classroom and the other half working in the department to which the student was assigned. They were charged a tuition fee of $100 for the course, but were allowed $40 a month for the work they did.

This course was quite popular and successful for a time. About eighty-five students graduated in it during the four years which it ran, and up to a year and a half ago about half of them still remained with the supporting companies. They were for the most part superior men and promising material for positions as department heads, but with the outbreak of the war, nearly all of them packed up their old kit bags and went away into the army and navy, practically terminating the experiment.

After the entry of this country into the war, it was found, not only advisable, but necessary, to materially change the course. The work was divided into five periods of three months each, the first two periods of which could be done during vacation time between school years. Instead of five half days each week being spent in the classroom, the new course provided for but one half-day classroom work a week, and instead of being paid $40 a month, the new rates range from $60 to $90 a month. As before the men are shifted around from one department to another, staying not long enough in

any department to become of much benefit there and not long enough to carry away very clear ideas of the details of the work of the department. It is believed, however, that after a student has been around in this way for a year or more, he will have a comprehensive general idea of how business is transacted in large corporations, how the different departments coördinate their work, and the relative magnitude and importance of each. This in general is the method which we are using to attract and to interest technical students. In normal times, with a less desirable course, we had to place a limit to the number we would admit to the course, but at the present time, we have less than twenty such students. Under the old course we paid them half as much and got twice as many.

I believe a sufficient time has elapsed so that I can now confess my lamentable ignorance of most things practical relative to mechanical engineering at the time of my graduation, and I have a keen realization of what a great benefit it would have been to me, if at the end of my sophomore year I had secured a job in a power house and had been put through boilers, turbines, auxiliaries and switchboard equipment, had such things been in existence in those days. I would have had a much clearer idea of the things that I wanted to study about.

This plan is working so well that it suggests the advisability of not waiting until the end of the sophomore year before starting this practical training. The cadet might be taken in at the end of his freshman year or even during his high school. A young man who has spent three months of the year for four to six years in the various departments of a large company will come near knowing what the company is made of and he would, after graduation, be already equipped for a very satisfactory position.

I mentioned that eighty per cent. of the graduates of this course left us at the beginning of the war to go into the army or other military occupations. All together, one thousand

men have gone from our company and many of them are engineers. We view with alarm, to use that expression, the situation which will exist at the end of another year or two of war should this condition keep up. Not only have our old men gone, but we are not getting new ones. The very men that we want the government is combing the technical schools to get.

We believe that a serious mistake is being made in allowing our engineering students to quit their work and go into the army, particularly where they are going into what you might call non-technical positions. This is true not only of the upper classes, but of the lower classes as well. If the young men who left their classrooms a year and a half ago had then been compelled to go back to school and finish the year and come back this year and finish this year's work, the country would have had hundreds or thousands more engineers available now than it has. We cannot predict the duration of the war, but the longer it runs the more serious the situation will become, and unless some steps are taken to take care of this deficiency, we will have a very serious situation.

Various schemes have been proposed for maintaining the supply of engineering students, and out of it all I sincerely hope that something will come. You doubtless are familiar with the experience of Great Britain at the outbreak of the war in regard to their medical students who quit their medical courses and volunteered as soldiers in the first rush. Naturally, many of them were killed, and after a few months the authorities realized what a serious mistake had been made. They took the remaining students out of the army and sent them back to their schools. It may be that some such action on the part of this government in reference to the engineering students would be advisable at this time.

SUGGESTIONS FOR CONSIDERATION.

F. H. NEWELL,

Professor of Civil Engineering, University of Illinois.

The following suggestions are offered in the hopes of arousing discussion, either here or later, of some of the fundamentals of our vocation. Viewing it in a large way, the first impression of the business of engineering education had by an engineer coming from so-called "practical life" is the absence of definite plan and of what are usually termed "efficiency" methods. There seems to be little attempt at economy of effort or of time either for the students or for the instructors. This condition arises presumably from lack of general agreement as to what we are really doing or from a failure to obtain clear conceptions as to the objects we are trying to attain. There seems to be little or no coöperation effort in a large way among instructors of engineering nor coördination among the various divisions of instruction; little or none of the well-organized team play so essential to success in our highly developed business or industrial life in which our students are soon to engage.

In the present crises there is special need of clarifying and re-stating our ideals. To stimulate such action this condensed abstract is offered:

1. We are in a war in which the whole world is concerned.
2. This war in magnitude, intensity and destructiveness exceeds every other calamity.
3. It is likely to continue indefinitely with increasing destructiveness.
4. It is not a war of brute strength, but of engineering devices.
5. The side more likely to win is that which most quickly

invents and successfully utilizes various engineering devices. Time is an essential element.

6. To invent and to successfully utilize these devices more and more engineers are needed.

7. Whenever the war terminates there will be additional needs for engineering skill to repair the destruction wrought.

8. The rapid changes which are taking place in all affairs is being accompanied by equally far reaching changes in engineering methods.

9. These changes are of supreme concern in engineering education.

10. Educational methods should be quickly and effectively modified to anticipate or meet the demands of this new world of experience and ideals.

11. The government of the United States and many of the larger industries, connected directly or indirectly with the war, are calling for young engineers qualified to meet modern needs.

12. It is the business of the members of the Society for the Promotion of Engineering Education to manufacture young engineers from the raw materials.

13. It is important to do this as rapidly and effectively as possible, to begin now to increase the speed.

14. If the above statements are correct, it is our duty to lose no time in this important matter; but first we may ask

15. What is the Society for the Promotion of Engineering Education and what are its objects?

16. The constitution does not state any object; this must be inferred from the name and character of membership.

17. The membership comprises those persons who occupy or have occupied responsible positions in the work of engineering instruction, together with engineering practitioners and others interested in engineering education.

18. These members are brought together to promote engineering education. Are we doing it? To answer this we must agree as to what is included in "promotion."

19. Promotion, according to the dictionary, is to contribute

to the growth, enlargement or prosperity, to encourage, to advance, as "to promote learning."

20. There is also a somewhat peculiar secondary meaning in American usage in that to *promote* any enterprise implies doing it with vigor and with the full use of all resources available regardless of consequences.

21. In the full sense are we really *promoting* engineering education? Are we contributing to its growth, to its enlargement, are we advancing it or is the rapid evolution of engineering methods dragging us with lagging feet in its train?

22. To promote any enterprise of the kind we must have

(*a*) materials,

(*b*) methods and

(*c*) men.

Are we advancing in each of these?

23. In (*a*) materials we are falling behind in the sense that the materials we work upon are young men. We have a fewer number each month. Are we using our resources effectively to get young men?

24. As a rule engineering colleges have pursued a dignified course and have not gone in an active, businesslike way into the high schools, or into "the high-ways and by-ways" to get needed material.

25. Are we doing our full duty if we do not exhaust every reasonable, and some unreasonable, means to let the grown boys know of the opportunities offered in engineering education and the needs of the nation? Are we truly promoting our work unless we do this?

26. After getting the students, are we using our full efforts to keep the best of these in college by urging the adoption or improvement of a system of detailing the enlisted men to intensive college training until they graduate?

27. In (*b*) methods we are less derelict; we have devoted most of our energies to discussion of these—but have we really kept up with the new generation and are we actually putting into practice the theories which we are discussing?

28. In our present methods—a relic of the scholastic past,—are we not wasting time of the students and instructors in lost motion—in non-essentials, in vacations, etc.? By speeding up can we not accomplish in three years all we are now trying to do in four years?

29. In (*c*) *men* are we keeping up? To get and keep good instructors we must see that they have more than a bare living wage. Are we doing this? Are we not keeping as instructors the rejects from better paid engineering work?

30. The depreciation in purchasing power of gold is such that salaries of say $1,600 today are equivalent to not much more than $1,000 in a former decade. Our instructors with increased experience are getting less than in former years. What are we doing to promote engineering education in keeping those necessary men?

31. In this day and crisis in human affairs we are expected to try to be 100 per cent. efficient; are we doing it, or are we presenting an attitude of apology for occupying the time and space which might be better used?

32. In conclusion to "promote" engineering education we should concentrate on effective schemes for

(*a*) More materials—more students to be attracted and held.

(*b*) Better methods—less wasted time.

(*c*) Better men—more pay for instructors to keep up with past salaries and to prevent the better men from going out of educational work.

In the consideration of some of the items just given—comments have been made in conservation. Notably President Charles S. Howe, of Case School of Applied Science, referring to the need of getting more materials to work upon (paragraph 23) has told how he has already initiated a thorough canvass of high-school students. The success of this can be ascertained only after the beginning of next winter's work. On the whole the persons who have discussed such efforts have seemed to think that they are well worth attempting. Moreover under the conditions of modern life, it has been found

that every similar enterprise must conduct well-planned publicity of advertising campaigns to secure an adequate supply of the material upon which to work.

In November, 1917, Prof. H. H. Jordan, assistant dean of the College of Engineering, University of Illinois, secured from 297 students in the freshman engineering class replies to questions intended to bring out the reasons why they came to the university and also as to why they chose engineering instead of some other college.

The answers indicate clearly that the students, in their own minds at least, were convinced that they had made the decision to enter the college without much help from parents or teachers. The controlling factor seems to be the advice or suggestions from people who have never attended college and particularly from persons connected with contracting or engineering firms. It appears that about half the high schools have tried to bring to the attention of students the advantage of a college education and that a few instructors in these high schools have attempted to analyze the native ability of the boys and to advise accordingly.

The reason as to why the engineering college has been chosen is largely because the young men, through work with engineers or contractors, have become interested in this occupation. Nearly two thirds of the engineering students have one or more relatives engaged in engineering. Only 12 per cent. indicated that the occupation of their father was engineering, while 95 per cent. of the freshman class had parents neither of whom had been to college. A large majority, or about 80 per cent., of the students assert that they have definite knowledge of the fact that the financial returns in the engineering profession are less than those in other professions.

If the above noted conditions are typical, it appears that in order to attract more young men and to arouse in the high-school students an interest and appreciation of the value of engineering education, certain systematic work should be pursued more largely through engineers and contractors, calling to the attention of each of them his particular duty as a citizen

to make known to the bright boys in his neighborhood the opportunities offered by the engineering colleges, also the advantages possessed by a young man who has made use of these opportunities. It appears that the American boy is guided more by examples and by advice of this kind than by anything his parents or teachers can or do say to him. It is the environment outside of school and home which appears to influence his choice of future occupation.

With reference to economy of time (paragraph 28) several educational institutions have already begun to seriously consider this. The most interesting case perhaps is that of the University of Missouri which in its new three-term calendar states:

"The war has made it necessary to increase efficiency in educational enterprises as well as in enterprises of other kinds. The necessity of conserving time and eliminating the waste of holiday and closed seasons has led the University of Missouri to adopt an all-year calendar, which, it is believed, will prove equally desirable as a peace-time program.

"Beginning with the next regular session, which will open for registration August 30, 1918, the school year of the university will be divided into three terms of sixteen weeks each, instead of two semesters, of approximately the same actual length, as heretofore. Under this plan the university's educational machinery will be in operation during the entire year, with the exception of two weeks in the latter part of August and a week at Christmas.

"These terms will be known as the fall, winter, and spring and summer terms. Students may take only one term a year or all three, though it is believed that in most cases best results will be obtained by studying not more than two and one half terms consecutively."

An equally important but perhaps more difficult question is that brought up in paragraph 29 with reference to getting and keeping good instructors. The time has arrived when the full sunlight of publicity should be turned upon the profession of engineering education. A careful examination

should be made not only into the present conditions, qualifications, activities, and pay of the instructors, but also into that of men who may be utilized as instructors, together with a comparison with similar conditions in private and public service. In this age of organization when in almost every line of human activity united efforts are essential to human progress, the engineering profession stands out prominently through its disorganized condition or rather multitude of unrelated societies and lack of unity on all important questions.

Individualism in ideals and methods has been carried to an extreme with the result that while engineers as such are performing great work for the country, yet as a body they are practically unknown and unrecognized in larger public affairs. In fact it may be said that taking the man on the street while he knows what is a doctor, a lawyer, or an architect and recognizes the authority with which their organizations speak, yet his definition of an "engineer" rarely gets beyond that of "a man who runs an engine," and his conception of an engineering organization is typified by that of the Brotherhood of Locomotive Engineers. He and his representative in the legislature or in Congress possibly never hear of an engineering society in the sense in which we here use the term.

Widely prevailing ignorance regarding engineering as a profession is due to the fact that we as engineers have made little effort to educate the public along these lines with the result that the public little knows and appreciates less what it owes to engineering, nor does it realize the vital importance to the community of getting and keeping effective engineering instructors. Failure in this respect is due to our own neglect.

We have a present duty to awaken or educate public opinion to a degree such that it will support the efforts to get and keep good instructors, securing for them a fair compensation. As long as the condition exists, as it does today, that many of our instructors can go out and obtain larger wages at skilled trades or even in simple mechanical labor, it is of course almost impossible to pick and choose our men. The fact that they can do this is in part due to the indifference of

engineering organizations. This has been fostered in part by a high sense of the ethics of the profession, looking down upon everything which savors of commercialism.

There are unfortunately no standards of salaries nor data by which these vital matters may be discussed. The American Society of Civil Engineers has made some investigations into the earnings of its members, but as yet there has not been a thorough, business-like or scientific analysis of what may be termed a fair wage or the relation of responsibilities or performance in engineering education to the compensation paid. The result is,—as in all cases of this kind where there is lack of information and of organization,—that the minimum wage is paid and there is strong temptation constantly offered for the more energetic men to accept tempting offers from outside.

On the other hand our instructors are required by custom to maintain a certain appearance of respectability. They share in the condition described by Gen. W. M. Black at last year's meeting as "nothing but genteel poverty from beginning to end." (PROC. S. P. E. E., Vol. XXV, p. 39.)

Again the question may be asked, "In view of these conditions are we as a society for promoting engineering education keeping up to the full degree of efficiency, one which we are supposed to demand from our students?" Are we not giving most of our time and thought to the minor, but more interesting details of our work, and putting to one side the vital problems of getting the necessary raw material, of finishing it off rapidly and effectively, and of getting and keeping the highest obtainable grade of instructors, "the men behind the gun" in our institutions?

WAR TRAINING ACTIVITIES AT THE AGRICULTURAL AND MECHANICAL COLLEGE OF TEXAS.

BY J. C. NAGLE,

Professor of Civil Engineering and Dean of Engineering.

The value of trained intelligence has been evident from the very beginning of the present world war. Profiting by the experience of the nations who entered earlier into the conflict the United States has had a better opportunity than they to marshal her trained intelligence, her man power and material resources. In the first patriotic rush to serve their country university- and college-trained men entered almost any branch of service in which they could find an opening, with the result that many who are equipped for special service, and as officers, are now serving in the ranks. Professors and instructors left their institutions to enter training camps, or to enlist in the ranks; older students were among the first to go; members of the alumni dropped their business callings, many of these having families to provide for, and hurried to answer the call. The attendance at higher institutions of learning dropped, especially in the advanced classes, and more or less demoralization existed among the classes remaining. Gradually, as time passed, conditions became better understood and the necessity for a continuance of educational preparation along the usual lines has been recognized, not only for the purpose of maintaining the supply of the technically trained for service in the prosecution of the war but for industrial service after peace shall have been restored.

The government recognized, from the first, the necessity of intensive training for troops before these could be employed at the front, and, very soon, also began making provision for

intensive training along special lines. The technical colleges and universities afforded especially favorable opportunities for carrying on a part of this intensive training, and the facilities of some of these have been taxed to their utmost. The Agricultural and Mechanical College of Texas is one of these. This institution, like the land-grant colleges of other states, owes its existence to an Act of Congress, approved July 2, 1862. In November, 1866, the Legislature of Texas, by joint resolution, accepted the provisions of the Act of Congress, and by an Act, approved April 17, 1871, the State Legislature provided for the establishment of the College, which was formally opened for the reception of students on October 4, 1876.

On March 21, 1917, seventeen days before the United States declared war against Germany, the faculty of the Agricultural and Mechanical College of Texas unanimously passed the following resolution:

"WHEREAS, The President and the Congress of the United States are confronted with a serious international crisis that may at any time result in a declaration of war; and

"WHEREAS, the Agricultural and Mechanical College of Texas is a land-grant institution established by an Act of Congress in 1862 presumably for the purpose of preparing men for military service and technical pursuits; and

"WHEREAS, the conditions of modern warfare demand technically trained men for military service;

"*Therefore, be it resolved,* that, we the faculty of the Agricultural and Mechanical College of Texas, earnestly request the immediate approval of the board of directors, sanctioned if necessary by the Legislature of the State, for the tender to the federal government of all research and instructional facilities at this college, the same to be subject to the direction of the Secretaries of War and the Navy, and that we hereby, individually and collectively, pledge our support to the international policies of the federal government and earnestly request the Governor and the Legislature of this State to assure undiminished the continuity of the appropriations during the continuance of such federal use irrespective of the suspension

of the instructional functions of any or all of the college departments. We urge the favorable consideration of this resolution by the board of directors of the college and if necessary by the Legislature also."

When the question of extending to the government the facilities of the college for intensive training of men, other than regular students (as contemplated in the resolution), was presented to the board of directors it was the unanimous opinion of the board that the college should aid in every way possible, and the president of the college was authorized to offer to the government the facilities of the institution for intensive training purposes.

On April 6, 1917, the United States declared war against Germany, and on December 7, war was also declared against Austria.

In what follows concerning intensive training at the Agricultural and Mechanical College of Texas there will be nothing said, the essential facts of which have not already appeared in the daily press or elsewhere, some of it in greater detail.

Three lines of intensive training are now being given at the college and the number of men in attendance at this writing is about fifteen hundred. Two of these lines, or groups, are in the Land Division of the Signal Corps, and the other is given to a Training Detachment of Mechanicians and Technicians. These will be considered under their respective heads.

Radio Mechanics.

On December 8, 1917, Detachment Depot Company K, Land Division of the Signal Corps, reported for training at the college. There were 107 men in the company, but later increments brought the number up to 128. They were assigned to quarters in one of the college dormitories and received their instruction, other than military instruction, in the Department of Electrical Engineering, the professor in charge of which being made Director of War Training Activities at the

college. He also directed the radio training work of the company. As the intensive training was enlarged so also were the duties and responsibilities of the director, until now he is a very busy man. He still directs the detailed work of the radio mechanics, however.

The course of study for this first company included the following subjects:

School of the soldier; school of the squad; school of company; Signal Corps drill; elementary electrical engineering; telegraphy; radio work; induction sets; pack sets; field work; visual signalling (day and night); telephony; dry and storage batteries; outside wiring; inside wiring; switch boards; construction of lance pole and tripod lines; paper work.

The original plan was to have this course cover twenty-two weeks, but in March, 1918, a change was made and the course was reduced to eleven weeks. The designation was also changed to "Signal Corps School for Radio Mechanics," and it was attached to the Air Division. A third change back to the Land Division has just been made and the designation is now "32d Service Company, Land Division" of the Signal Corps.

Of the original 107 men only 17 were operators to begin with, the others having no knowledge of radio work whatever, but by the time they were ordered away from college 24 had become 25-word operators, 12 were 10-word operators and the remainder 5-word operators. Thirty-two were assigned to field batteries for service abroad, twelve were sent to officers' training camps, and the others were assigned to various organizations as signal corps and telegraph operators.

For both the original company and the present radio school military drill and setting-up exercises occupied one and three quarters hours daily, for five days in the week. Saturday mornings are devoted to examinations and the men have Saturday afternoons and Sundays to themselves if their records are good. Otherwise they must work Saturday afternoons. A new class is started every Monday.

In addition to the drill thirty-nine hours each week are de-

voted to class room, laboratory and field work, the latter being confined to five of the eleven weeks. The hours in the class room range from three to twelve hours per week, those in the laboratory from eighteen to thirty-five, and those in the field from six to eighteen. The total number of hours, exclusive of drill, and setting up exercises, devoted to class room, laboratory and field work during the eleven-week course are 99, 277 and 53, respectively.

The subjects covered include, among other things; elementary electricity, elementary wiring, map reading, use of woodworking tools, batteries, battery charging, dynamos and motors, gasoline engines, radio work, buzzer practice, vacuum tubes, sending and receiving sets in laboratory and field, tuning and testing transmitters, and receivers, use of wave meter, air plane construction and fitting with radio devices, artillery cooperation, active service routine, locating and repairing faults, visual signalling, first aid, personal hygiene, Army organization, motor vehicles.

Of the men who are being assigned to college some are detailed from aviation camps in the state while others are inducted directly into the service. A large percentage of the most successful students come direct from their homes as volunteers. Some have been selected because of previous electrical or telegraphic experience. It has been found that at least two years of high-school training is necessary for satisfactory progress, and men having engineering training possess distinct advantages.

Upon completion of the eleven weeks' course some radio mechanics are assigned to aviation squadrons while others are detailed to radio schools elsewhere, a number to date having been sent elsewhere as instructors, and others for additional training. Those who are assigned to squadrons are given the rank of sergeants, or better (according to ability), where they must keep all radio equipment in working order, look after battery charging, wiring and lighting of hangars, and must test and inspect radio equipment on airplanes. Of the 287 radio mechanics who have been sent out from college since the

change from a twenty-two to an eleven-week course, 18 have gone to Austin as specially qualified operators and 8 as special mechanics to Pittsburgh; 127 have gone to the operators' school at Austin and 110 mechanics have been sent to Pittsburgh; 21 have been sent to the fort at San Antonio and 3 to a telegraph battalion. There are now in training at the college about 500 others and additional men are coming in daily.

In addition to the commanding officer and a number of field and office assistants an army surgeon guards the health of both radio mechanics and meteorologists.

School of Meteorology.

This branch of the Signal Corps service has only recently been added to the work of the college. On May 24, 301 men reached college and are now undergoing intensive training. About one hundred more are due to arrive shortly and the number, it is expected, to be trained at this station is 1,000. The institution work is in charge of three trained meteorologists, two of whom are civilians and one a commissioned officer. The number of officers connected with the military organization of this group has been increased from one to four, but this number is still too small. Many of the men have had experience in meteorological work and some of these act as assistant instructors. Also many have had more or less military training and assist at drill and setting up exercises.

This group is composed almost altogether of university and college graduates, there being less than ten per cent. of the first three hundred who do not hold collegiate degrees.

The details of the course are being worked out as instruction proceeds and the writer has no definite information as to just what is contemplated. A regular Weather Bureau station, equipped with electrical recording devices, has been installed on the roof of the civil engineering building and a portable installation has been placed on the ground for ease of instruction, at a nearby point. At still another point an additional rain gauge and thermometer shelter have been placed on the

ground, this also for instructional purposes. Daily meteorological maps are prepared by the students, and daily cloud observations are made by them under direction of an instructor. Base lines have been measured and a triangulation system is being worked up for the purpose of studying air movements by means of rubber balloons, upon which simultaneous thredolite measurements will be made from triangulation stations.

The regular course is scheduled to be two months long, but a section of the class is being given even more intensive training in order to be ready to go to other places at an early date. Military instruction in drill and setting up exercises are given for an hour and a half daily. The students have Saturday afternoon and Sunday off, but many of them work straight through. Night classes are being held for those who are to have less than the full two months time, and all have one study hour each night.

Service Training Detachment.

This section of the intensive training work was begun on April 15, 1918, with 320 auto mechanics, 25 blacksmiths and 25 machinists detailed from the 370 men who had been sent here by the local draft boards. Only 350 were expected, but the Agricultural Engineering Department, which has charge of instruction work of auto mechanics, was able to quickly organize the number sent, as was also the Mechanical Engineering Department, which has charge of the blacksmiths and machinists.

On June 11 the above 370 men had completed the courses laid out for them and were ordered away. On June 15 about 765 of the 772 men expected reported for the second course. These men came also from their homes under orders from their local draft boards. No additions to the officers in charge had been made when the men came and the captain commanding, quartermaster and three lieutenants had their hands more than full in listing and organizing them. The number of field officers was increased to eight a few days later and with the

larger complement of officers the work should be somewhat less strenuous for all of them than was the case for the first detail. An army surgeon has been stationed at the college to care for the health of the men.

It was remarkable to see the improvement effected in the two months. After the first week the men had learned the rudiments of drill and marching formations, and when their uniforms arrived at the end of about three weeks the transformation was striking. Earnest effort marked the manner of the men of this detachment from the first, as has been the case with the other detachments, also. The others, however, came in uniform, for the most part, and had evidently had some military training before coming.

Members of the second group of the training detachment have been assigned to different branches of instruction about as follows: Auto mechanics, 670; horseshoers, 15; blacksmiths, 15; machinists, 25; carpenters, 40. The Agricultural Engineering Department is handling the auto mechanics, as for the first group, and the Mechanical Engineering Department has the horseshoers, blacksmiths and machinists. The 40 carpenters have been assigned to the Department of Buildings and Grounds, which will utilize the services of the men, while at the same time instructing them, in building additional wooden barracks and in doing other kinds of carpentry work such as is required at cantonments and permanent camps. Some bench work in the carpenter shop will probably also be given, as well as instruction in reading working drawings and blue prints, etc.

The course of instruction for the horseshoeing course, just being inaugurated, has not been worked out in detail at this writing. That in the blacksmith shop will be substantially the same as was given to the first group, which began with elementary forging and welding, both of iron and steel, and of steel to iron, making shop and field tools, tempering, case hardening; working to dimensions; tire welding and setting; miscellaneous repair work, such as repairs to parts of automobiles, welding and tempering springs, etc.

In the machine shop instruction is given in the simpler bench and machine work first, operation and use of lathes, milling machines, etc., followed by more complicated machine work, such as turning tapers, screws, etc.; tool making, tool grinding, miscellaneous machine work, automatic machine work, etc. A feature of the course is covered by coöperation with one of the large railway systems which operates through the state. The railroad furnishes the stock material, sample pieces, blue prints of working drawings, etc., for actual railroad parts and the students make or repair these parts in the college shops. Some of the articles made or repaired belong to locomotives and others to cars, such as nozzles, brackets, hangers, chains, etc. This work connects up with the blacksmith shop work and the idea originated with the professor of mechanical engineering.

For the first group instruction in carpentry was given by the Mechanical Engineering Department, but as stated above, will be taken care of by the Department of Buildings and Grounds with the second group.

The Agricultural Engineering Department secured old automobiles and trucks, and were assigned a number of government trucks, some of them of the four-wheel-drive type. Additional autos and parts have been added to provide for the increased numbers in the second group. Instruction for the first group was given in 10-day periods and covered the following five divisions: Studies of and practice with the chassis, motor, electrical equipment, driving and lubrication. The group was divided into sections and the sections into squads and work in all five divisions progressed simultaneously. For the second group the number of divisions has been reduced to four, the lubrication part for each division being made a rider for the more exhaustive work preceding in those divisions where lubrication is needed. The four divisions now are: Motor, and its lubrication; chassis, and its lubrication; electrical equipment, and radiator repairs; driving, and tire repairs.

There are eight instructors provided for each division and one head instructor, making thirty-three skilled civilian in-

structors, all guided and directed by the professor of agricultural engineering, who takes care of the administrative work of this branch of war training activities.

In each of the four divisions the men are divided into sections of twenty, each section in charge of an instructor. These instructors are, in many cases, making considerable sacrifice of personal interests in order to do something to help the cause of the nation. Each section is divided into squads of four to six men each so as to work the men to the best advantage. Each division has its own laboratory manual (mimeographed) and a long list of questions and answers, to be studied by the students outside of the class room. A grade card is made out for each man, on which each instructor indicates on a scale of 5, his estimate of the student's ability on the scores of mechanical ability, speed, resourcefulness and personal qualities. The student is also given an examination grade and a shop grade.

In the motor division students take down and assemble a number of different types of motors, taking a new type each day. They work in squads of six and grind valves, scrape bearings, make adjustments of timing gears and other parts, experiment with the running of motors, adjustment of carburetors, etc., and study the behavior of engines under varying conditions.

This work covers six days and the seventh is devoted to a study of motor lubrication. Under this head they learn the right kind of oil to use and where to use it.

In the chassis division the men study the frames, springs, axles, housing supports, brackets, clutch, transmission and levers, universal joints, differential and other parts. They take apart and replace these parts, lubricate and reassemble them, and learn where to look for wear and breakages. The seventh day is devoted to lubrication of all parts of the chassis.

In the electrical division they study dry cells, storage batteries, magnetos, coils, steering and lighting system, wiring of different automobiles and motor trucks and general troubles

in running motors. They are even made to rewind coils, not that they will probably have this to do in the field, but in order that they may better know where to look for trouble. The seventh day rider in this division relates to radiator repairs, both temporary and permanent, repairs of carburetor floats and miscellaneous parts generally.

In the driving division the men are taught to drive automobiles and trucks under all kinds of adverse conditions. They must cross narrow bridges, run their trucks into sink holes, mire them down in mud and then extricate them; they must learn to stop at a given point suddenly indicated to them; must drive forward and backward between curved lanes of stakes without knocking one down, and must qualify on a number of other tests. They drive without lights at night over a twenty-one mile course and return over the same course in the same way.

In this division they are taught all kinds of emergency repairs, on solid and inflated tires, and other parts. In fact tire work constitutes the rider in this division.

About one eighth of the time is devoted to lectures and the remainder to actual practice.

At the conclusion of the 28-day course those men who show special aptitude for particular divisions of the work will devote the remaining 22 days to this special branch or branches and so become more proficient in that for which they seem best qualified.

In all the intensive work now being given at the college the percentage of failures has been surprisingly small, especially when we remember that many of those who take the work, especially that of the training detachment, have been clerks, stenographers, office men, etc., who have had no previous experience along related lines. A large proportion, especially of the Training Detachment, come from the farm, but the average western farmer has had to exercise his ingenuity in mechanical matters, so that his advantage here about balances

any lack of opportunity for mental training which he may have been denied.

Relation of War Training Work to Usual College Activities.

Prior to April 15, 1918, the number of intensively trained men at the institution was not relatively large, and the 128 signal corps men then here were accommodated in one dormitory for the time they were here. Later, as the student numbers decreased by reason of so many, especially of the upper classmen, entering the service and the numbers of enlisted men increasing, another dormitory was assigned to them.

The college has nine dormitories, but after April 15 these were inadequate for both student body and enlisted men, and the old assembly hall was converted into barracks for the men. For a short time a section of them were also housed in the gymnasium. During the early part of June a two-story wooden barrack, built according to army plans, was run up in a few days and another of the same type is now under construction. Two others will be added at an early date and it is expected that the 40 carpenters in training will be utilized in their construction. Each of these dormitories will accommodate 200 men, and the four will form the sides of a quadrangle, situated in the rear of the principal college buildings. Each barrack is fitted up with the usual toilet and shower bath facilities, just as in the army cantonments, and have sewer connections.

The problem of instruction space for the 320 auto mechanics was solved by the use, in addition to the building and facilities of the Agricultural Engineering Department, of a large stock judging pavilion which had recently been added to the college equipment. This building seats about 2,500 people and has a large arena which not only served for instruction on chassis but at one end afforded storage space for several instruction aëroplanes. In order to provide sufficient space for the largely increased number of auto mechanics a wooden

building, measuring 100 by 240 feet in plan, has just been completed. This will provide space for instruction for 1,000 men who are expected to be in training within a few weeks.

The radio mechanics and meteorologists receive their instruction in the electrical engineering and the civil engineering buildings, respectively, and the officers and instructors for these have their offices also in these buildings. The officers of the Training Detachment have an office in the Academic, or main college building. The problem of providing accommodations for the officers and their families has been one of the most difficult to solve. College Station is composed solely of the Agricultural and Mechanical College of Texas and the buildings pertaining to it and the Agricultural Experiment Station. The number of residences provided is inadequate for the regular employees and many of these live in Bryan, five miles away, and go to and from their work by trolley or automobile. Somehow, however, the army officers have been provided with quarters so far. The residences of the place have lodged them wherever they could (with no small inconvenience to the owners in many cases) and the one hotel has been able to lodge others. The College Mess Hall, with seating space for over 1,500 at table, provides meals for the 1,500 soldiers now in training and for about 200 summer-school students in addition. Meals are also served to summer-school teachers and to a few army officers, in spite of the present great difficulty in securing competent help. The college hotel and a cafateria in the Y. M. C. A. building furnishes meals for visitors, of whom there has been an unusually large number since the training work began. Unless additional housing space can be provided during the summer the problem will be even more serious after school opens when some families, now absent, return to their homes which meantime have been occupied by the families of officers and instructors of the Signal Corps and Training Detachments.

It might be expected that the close contact between the regular student body and the enlisted men might cause some friction but such was not the case during the time of the regular

session. The fact that the student body was composed entirely of men minimized this danger, however. The two organizations took their meals at the same time in the mess hall but drilled at different hours. Their dormitories were distinct and so were their classes, though they used the same class rooms and laboratories. With the advent of the untrained freshman class in the fall there may be some difficulty of adjustment especially as the increased numbers of intensively trained men here will necessitate possible cramping of quarters, class room and laboratory space, but these are problems to be met when they arise. The college, and its faculty and other employees, is lending, and will continue to lend, every assistance possible to the preparation of men for early and efficient service in operations bearing upon the war situation.

Prairie View Training Detachment.

The State of Texas maintains a normal and industrial college for negroes at Prairie View, about fifty miles south of College Station. During the regular session there were more than nine hundred students in attendance, over two thirds of whom were women. There is a summer school now in progress, with about five hundred in attendance. Only a small percentage of the summer-school students are men. This institution is under the care of the same board of directors and the same president as the Agricultural and Mechanical College of Texas. The faculty and student body have evidenced a marked spirit of patriotism from the first, and the leading members of the faculty recognized the possibilities of such training as the Service Detachment offered as soon as this work was inaugurated at the Agricultural and Mechanical College. Negotiations were set on foot and arrangements made to take 150 drafted colored men for this work, beginning July 15, 1918.

To provide accommodations for the drafted men two of the men student's dormitories were renovated and set apart for the purpose. Old automobiles were purchased and three four-

wheel-drive army trucks were secured. Additional forges and tools for the blacksmith shop were purchased and new tools for the carpenter shop were added. On June 15, 158 drafted men arrived and others are still due. The number may reach 170, although preparations were made only for the 150 contracted for. The officers, consisting of a captain, commanding, one field lieutenant, one surgeon and one dentist were detailed to the school. The officers are white. The surgeon, just out of a hospital himself, arrived about June 10. The dentist came a few days later. Neither of these officers had any experience in commanding troops. The drafted men were on the ground four days before a line officer appeared, and he was sent over from San Antonio at the request of the president of the Agricultural and Mechanics College to take charge temporarily. The writer is not yet informed as to whether or not regularly detailed officers have reached the school.

Coming as they did from all sections of the state, from all sorts of occupations and living conditions, and being without control for four days, serious complications might have arisen, but there was not the slightest trouble, and when the writer saw them on June 19 they were being organized and instructed in their general duties and behavior.

The course of instruction to be given these men will be similar to that given at College Station. Just what the divisions will finally consist of has not yet been determined. The contract for the 150 men contemplated that 90 would be given the course in auto mechanics, 20 in blacksmithing and 40 in carpentry. On account of limited equipment it is probable that the number in blacksmithing and carpentry may have to be restricted to the numbers originally planned and the excess thrown into the auto mechanics division. Almost all of the men express a preference for the auto mechanics school.

This intensive training at Prairie View should have an excellent effect upon the regular student body, and should be an added evidence of the good work being done by colored teachers for the colored race at this school.

WAR ACTIVITIES AT THE WEST VIRGINIA UNIVERSITY.

BY C. R. JONES,

Dean, College of Engineering.

The problems growing out of the world war are much the same at every educational institution of college grade. The more general problems include changes in curricula and working schedules, introduction of special or new courses for regularly enrolled students, reorganization of the teaching forces to carry on the work with a depleted staff, placing students and alumni where they can render the service for which they are best fitted, and giving trade and special instruction for men subject to draft and for enlisted men. Each institution has been called upon to prepare its quota of reports and recommendations to the various divisions of the war and other governmental departments and it would be safe to say that there are very few instructors in any of the engineering colleges who are not undertaking some special war service in addition to their regular duties as teachers. The activities of the members of engineering faculties in connection with the Food and Fuel administration, four minute men, enrollment of labor, Red Cross, Liberty Bonds, War Stamps, Y. M. C. A., State Councils of Defense, War Intelligence Service, and special assignments would make a formidable list, while those of an entire institution would be beyond the bounds of an ordinary paper.

Without minimizing the importance of the special activities of individual teachers, the real function at this time is to help win the war and conserve the fruits of victory by turning out as many technically trained men as are needed for military and industrial service and in the shortest possible time. The purpose of this paper is to outline the efforts which have been

made at the West Virginia University to fulfill this function. As to numbers, we have to point to our honor roll to explain idle apparatus and the empty seats in the class-rooms. In speeding up the programme the continuous session for seniors held last summer and fall was the means of holding the majority of the best men in the class and enabling them to finish the work for their degrees nearly seven months earlier than if the regular schedule had been followed. As a paper on this subject read last December before the Engineering Division of the American Association of Agricultural Colleges and Experiment Stations has already been published in the proceedings of that organization, I shall only mention a few of the main facts. The session began June 15 and ended December 15.

The modified curricula omitted the writing of a thesis (3 hrs.), senior English (1 hr.), contracts and specifications (2 hrs.), and the work of the Engineering Society, counting for a credit of one hour—a total of eight hours out of thirty-six regularly required. By concentrating and intensifying the work, the schedules were so arranged that each member of the staff who took part in the work could have a vacation of one month at some time during the year.

The students were assigned fewer subjects at one time and the classes met four or five times per week instead of two or three.

No new courses were introduced but the points of emphasis have naturally undergone an evolution. Military applications in such courses as bridge construction, concrete and masonry construction, highway engineering, signalling, and gas engines were sought on the part of the students and naturally more attention was paid to such applications than formerly.

As an example, mechanical seniors have one optional subject to be selected from a group. Formerly electives were divided about equally between advanced courses in steam turbines, industrial management, materials of engineering, and gas engineering. This year all elected gas engineering and requested

that the time be largely devoted to internal combustion engines applicable to automobiles, tractors and aëroplanes. As a result this particular course had to be entirely recast.

When the plan was first suggested, there was no thought of limiting it to the senior class, but the committee appointed to work out the details came to the conclusion that the work of the first three years could not be abbreviated either in time or subject matter, and that the physical and mental strain on the part of the students in the lower classes for a session lasting continuously for two or three years would be too great. Financial and schedule difficulties could have been arranged. The seniors stood the strain of fifteen months' continuous work without a man dropping out on account of his health, but they were pretty well exhausted at the close of the session, indicating to us that the decision of the committee in not extending the provisions to the lower classes was wise.

Both faculty and students are well pleased with the results of the session and the same plan is being followed again for senior mechanical, electrical and mining students. The senior civils preferred to work during the regular vacation period and all of the civil engineering staff have special government assignments.

While the number of credit hours was reduced, the quality of work done was of high order and all agree that no real sacrifice was made from the standpoint of scholarship and amount of work actually done. All agree that the concentration of the student's attention on fewer subjects at one time was one of the main contributing causes of the success of the plan. The losses from failures and from students' dropping out were not heavy. Three students were called by the draft, but only one called for service; one student was unable to keep pace with his team mates and failed; two had conditions or failures in one or more subjects, one of these removed his conditions by remaining for another semester and the other left in January for the third officers' training school and did not receive his degree. Of those who were enrolled, all but three received their degrees.

Some of the points to be considered favoring success of the plan are:

1. That all who expected to remain in school wanted the continuous session and all came back. One had to be refused because of back work.

2. That those who elected to remain with one exception were unusually strong men.

3. That the classes were small so that the individual members received more personal attention than they could ordinarily have been given.

4. That the summer was cool and almost ideal for study and work.

5. Preparation for the immediate future was a strong incentive for high class work.

All concerned are highly pleased with the results and are willing to continue the plan as long as the present emergency lasts, but as we are organized, the work is too strenuous for both faculty and students for times of peace.

Special Courses Given in the Regular Session.

In addition to the work of the continuous session for seniors, special courses, graded to suit the applicants, have been given in such subjects as gas engines, automobile work, drafting and radio work to regular students preparing for military service; and day and night classes in subjects below college grade were organized for men subject to draft.

Training Detachment.

At the present time one hundred and seventy-four enlisted men are quartered in the armory and instruction is being given in automobile repair work, woodworking, machine shop practice, gas welding, blacksmithing, sheet metal work, electrical wiring, electrical operation, armature winding, telephone work and radio mechanics .

The men sent were all picked and are making rapid progress. As soon as housing facilities are arranged, additional men can he handled.

EFFECT OF THE WAR ON ENGINEERING GRADUATES AND THE INDUSTRIES.

BY G. H. PFEIF,

General Electric Co.

The war has emphasized the extent that our present civilization and its maintenance are dependent on the engineering graduate. We have all accepted modern conveniences without much thought of the engineering skill involved in their production, but modern warfare, with its airplanes, submarines, heavy artillery and other destructive agencies, has shown clearly the need and value of technical training.

When it became evident that our country would take an active part in the war, the first call came for suitable men for training as officers. It was soon demonstrated that men with technical training could readily grasp the fundamentals and principles necessary for the development of a civilian army. Similar conditions existed in the Navy, to a lesser extent, and the expansion of this branch of the service required trained men for the operation of modern equipment on battleships, destroyers and submarines.

Engineering graduates left the industries by the hundreds to take up such work. Others have taken positions in other branches of the service; such as Ordnance, Inspection, Aviation and Signal Corps and to-day the demand is greater than the supply. Almost all of the class of nineteen-seventeen in the engineering colleges have been absorbed and the various engineering organizations have been depleted to such an extent that their efficiency is threatened. It seems that the supply of technical men in the country has been drained during the first year of the war and no adequate provisions have been made for the future. Should the war be of short duration this would not be a matter of prime importance but, on

the other hand, if the war is to continue for a considerable number of years, the situation must receive intelligent and far-sighted consideration.

Our engineering industries are confronted with the big problem of furnishing equipment and munitions, and this has resulted in the building of new munition plants of all kinds, ship-yards, power houses, textile mills, etc., all requiring engineering skill for rapid construction and efficient operation. Hundreds of ships are under construction requiring engineers for the design, supervision of construction, installation of equipment and operation. The manufacture of war materials has added many problems to the work of established organizations. The production of munitions, the reduction of importations and increased demand have created a scarcity of various materials. The engineer has had to produce substitutes which would be equivalent or devise new methods of construction. Speed is essential and in the electrical field the application of the steam turbine and electric motors to ship propulsion, the development of the wireless telephone, the production of searchlights, signal corps apparatus and submarine equipment and detectors have added to the duties of the engineer. Many of the parts are given their first trial under operating conditions, adding to the responsibility and increasing the necessity for accurate work.

Prior to our entrance in the war, it was said that the enemy was superior in engineering skill but subsequent events have shown that it was superior organization. We should, therefore, establish closer coöperation among our engineers. In many cases, men in professional life have offered their services, either partially or entirely, but we have a great amount of engineering talent, especially in the technical colleges, which has not been utilized. These men are anxious to help and can render useful services if called upon by the government or by the industries in a consulting capacity or for the solution of special problems.

It is easy to train men for various shop operations involv-

ing the use of a single machine tool and the production of standard parts but it has been demonstrated that men cannot be trained for technical work in a shorter time than it takes in the technical colleges. The loss of many men has made it necessary to increase the executive work of the engineers remaining in the industries and girls, or men outside of the draft, have been supplied for calculating and elementary work. However, the engineering college must be given more recognition if we are to have enough engineers to win the war and hold our place in the industrial world in the future.

To this effect, the following suggestions are offered as a possible basis of improvement:

1. Professors and instructors, teaching engineering subjects, should be given deferred classification on the same basis as other occupations.

2. All students whose work is satisfactory should be allowed to remain in college until graduation.

3. All graduates should be assigned to engineering work, either in the service or in the industries.

4. Promising high-school boys should be encouraged to enter college and, if necessary, a part of their tuition should be paid. These boys could be selected from scholastic records or by competitive examination. This should receive special attention in view of proposed changes in the draft.

5. Engineering graduates, enlisted or drafted as privates, should be transferred to technical work. The present system of classification does not seem to be entirely adequate in this respect, as a number of recent graduates are in service which does not utilize their training. Such cases should be called to the attention of the various sections of the War Department which are in need of technical men.

6. Recognition should be given engineers of draft age who remain in industrial work. These men are rendering valuable service but are often judged as slackers by people who cannot recognize service without a uniform.

The engineer has not taken the part in political life to which

he is entitled and, until recently, has not had sufficient representation in the councils which have formulated present policies. As a result, there is a feeling that there is no scarcity of engineering material and no danger of a shortage after the war. In the industrial world, the shortage is acute at the present time and the continued expansion of the army and navy will increase the difficulty of obtaining technical men. Every effort should, therefore, be made to maintain a normal number of students. They will be needed, not only for military work and the production of war material but for the production of the ordinary necessities of business after the war. The cost of labor has increased to such an extent that the highest grade of engineering skill and manufacturing efficiency will be needed if we are to compete with the cheaper labor of Europe and the Far East.

Any concerted action by the various engineering societies which would tend to improve existing conditions will meet with the coöperation of the industries.

DISCUSSION.

T. U. Taylor: Mr. Chairman, there is one question that has been suggested by this paper. As I understand it, men in the draft age in the industries are to be given some recognition. What do you have in mind?

G. F. Pfeif: That they be given a badge or insignia of some kind. Some are being proposed for the men in the Emergency Fleet service, showing that they are engaged in government work. It is simply some indication that they are doing useful work.

Dean Taylor: And to protect them from being called slackers?

Mr. Pfeif: Yes.

Dean Taylor: Well, how about those professors in college turning out those men?

Mr. Pfeif: They are the first ones I mentioned.

Dean Taylor: I didn't know but what you had in mind because this is entirely outside of the military plan.

THE BUREAU OF EDUCATION AND THE WAR.

BY S. P. CAPEN,

Specialist in Higher Education.

War was responsible for the participation of the United States government in education on a national scale. Probably the greatest contribution made by the United States to educational practice is embodied in the system of land-grant colleges. The act creating these institutions was passed in 1862, in one of the most critical periods of the Civil War. The need for a larger development of technical training which that struggle brought forth led to the establishment of these institutions. The Bureau of Education likewise, which was founded in 1868, was less directly an outgrowth of the Civil War. The war emphasized the importance of the nation's educational enterprise, and this office was created to study that enterprise and record its activities.

The Bureau of Education, however, was organized distinctly as a peace agency. Primarily it was intended by Congress to be an information office. For a number of years its sole task was to maintain a historical and statistical record of what was being accomplished in the various fields of education in the United States and in foreign countries. But the idea has gradually spread that, by virtue of its long life and its large accumulations of material, its advice may have some value. As the years have passed its counsel has been more and more sought by those in charge of educational institutions. It has come to have a constantly widening influence, not equally strong in all fields, of course. It is worth emphasizing, however, that the Bureau of Education has no power over American education and no administrative authority except over the schools for natives in Alaska.

Now, such influences as it exercises comes from two sources: first, from the fact that it is a government office. The government's name carries weight in many quarters. But probably the more enlightened are not much impressed by the name alone. Much more important is the influence which the bureau acquires through an experienced personnel. In other words, what the bureau does and says has weight when it is inherently sensible. If it is not sensible it has no weight at all.

The present commissioner has believed that the time has come for the government's principal agency for education to assume a more active leadership; not to remain silent until its opinion is sought, but to urge upon the country those policies which it judges to be advantageous. It is strategically placed for such service. In fact, no other body can command so wide a view of the whole educational situation. Under Commissioner Claxton the bureau had before the war become to a certain extent a center of propaganda for what it regarded as the most vital movements in educational administration and in teaching. I think it may safely be affirmed that through these activities it has made a very valuable contribution, especially in the fields of rural education and the state administration of public institutions.

With the entrance of the United States into the war there was, as every one who visited Washington at that time knows, a period of frantic milling around. No government department was organized to undertake effectively the new tasks suddenly thrust upon it. The Bureau of Education, no better equipped for an emergency than any other department, was faced with a very grave responsibility, which I believe it recognized fully from the outset. For three years it had watched the vicissitudes through which the schools and universities of the belligerent countries had passed. It had seen that the effective conduct of a modern war depends on a personnel skilled not alone in the traditional arts of the soldier, but in a great variety of technical specialties. It realized that if the struggle were going to be long, not only must the existing edu-

cational facilities be kept functioning, but new ones must be created. It saw that we could safely proceed only on the assumption of a long war and that we must be prepared to make good in part the loss of skilled men already experienced by the allied countries, as well as to conserve an adequate supply for our own military efforts. At the same time it perceived that readjustments would have to be made in the educational processes of the United States and that an intelligent criticism of the new projects should be furnished by some central agency. Very likely the bureau has not always been as wise or as effective as it might have been in meeting these obligations during the last fourteen months. Others can judge of that more appropriately than I. At any rate, I think I can fairly assert that it envisaged the problem at once and that it has done that thing than which angels can do no more.

In meeting what it assumed to be its new responsibility the bureau's activities fall into several categories.

Effort to Preserve and Utilize for War Purposes the Agencies for Technical Training.

First in point of time, and certainly not the least in importance, was the bureau's campaign to preserve and stabilize higher education, especially higher technical training. We desire no exclusive credit for what little has been accomplished. Indeed, many agencies, among them your own association, were active toward the same end. But the bureau adopted the policy of working with anybody or any group which could contribute to the cause. I think it may justly claim to have served as a kind of liaison office to keep all the various efforts together and headed in the right direction. For example, it joined forces cordially with the Education Committee of the Council of National Defense. It was represented by one of its officers on that committee and published all the committee's reports and communications.

In this connection it may not be out of place to recall that the meeting of college officers which resulted in the forma-

tion of that committee, put itself on record as follows: "We believe that in view of the supreme importance of applied science in the present war, students pursuing technical courses such as medicine, agriculture, and engineering, are rendering, or are to render through the continuance of their training, services more valuable and efficient than if they were to enroll in military or naval service at once." The meeting also passed resolutions to the effect that a statement should be issued by the Bureau of Education embodying a comprehensive policy of coöperation between the government and the colleges, universities and other schools "which will make for the most effective use of these institutions throughout the duration of the war." This mandate seemed very simple a year ago. Now it appears to have been very naïve. It has taken more than a year and the efforts of more than one committee to secure even a partial statement of the government's policy toward educational institutions. The reason, of course is that the government hadn't a policy. For more than a year one has been slowly and painfully developed. The Bureau of Education has without doubt had a hand in its making.

Having given publicity to these and other resolutions of the Council of National Defense, the bureau proceeded to reënforce them. It called Secretary Lane's attention to the situation in which colleges, and especially engineering schools, found themselves, and through him it secured, last July, a statement from President Wilson which helped for a time to steady conditions. It issued similar statements from the Secretary of War and the Commissioner of Education. It issued a special document pointing out the vital importance of higher technical education, especially engineering education. Later on it presented the question of the depletion of our scientific reserves to all the principal university and college associations and assisted these bodies to get their views before the War Department.

Viewed in retrospect, it is apparent that the cause of most

of the difficulties which colleges have faced for the past year was the lack of an agency in the War Department itself to consider the question of training in a comprehensive way and to make use of the vast training facilities afforded by civilian institutions. Whatever the opinions of the secretary and the heads of staff corps with regard to the greater serviceableness of men who had finished their technical education might be, the inexorable machinery of the Selective Service Law operated to drive technical students into the Army prematurely. An agency was needed to study the whole problem, to formulate an educational policy for the Army, and to improvise adjustments which would enable colleges to make their full contribution to the military establishment without doing violence to the admirable purpose of the Selective Service Law. It was distinctly a War Department job, one that could not be done for the War Department by any other body. Unless I am mistaken, the need was first clearly seen by one of the subcommittees of the Council of National Defense, the Committee on the Relation of Engineering Schools to the Government of which Dean Bishop was chairman. Undoubtedly the efforts of many others contributed finally to the establishment of the War Department's Committee on Education and Special Training (about which you are to hear shortly), but this committee of the Council of National Defense brought the whole question to the attention of the Secretary of War last summer. He at once appointed an officer of the General Staff to study the needs of the War Department for technically trained men and the methods of securing the coöperation of educational institutions toward meeting these needs. This was the first step toward the systematic treatment of the War Department's educational problem. The Bureau of Education takes some pride in having been represented on this committee and in having given wide publicity to its reports.

The formulation of a government policy with reference to the use of the educational facilities of the country involves more than the War Department, however, and more than the colleges. Various ill-considered plans have originated

throughout the country tending toward the disruption of school work and the drawing off of boys and girls for various kinds of auxiliary service. Early in the year the Bureau of Education consulted all the government departments whose activities might remotely affect the schools, and drew up a statement entitled "Government Policies Involving the Schools in War Time," which was signed by the Secretaries of War, Navy, Agriculture, Labor, and Interior, the chairman of the Civil Service Commission, and the Commissioner of Education. Probably no more useful service has been rendered to public education in the last twelve months. A second statement setting forth particularly the contributions which public schools may render in scientific and technical education, in view of the war emergency is about to be issued.

Promotion through Educational Agencies of Special Emergency Movements.

I have noted that the Bureau of Education had begun before the war to act as the promoter for certain educational movements which it regarded as particularly worth while. In the last year it has advanced three such movements, which have gained special prominence through the war emergency.

The first of these is more or less of an old story, but a new meaning has been given to it by the war and by the revealed conditions in army camps. I refer to the Americanization movement. The Bureau of Education has been for a number of years one of the most diligent advocates of a definite and practical policy for assimilating the immigrant. It has worked out a large body of teaching material and it has induced various state legislatures and city authorities to provide for systematic efforts toward Americanization. Nevertheless, its labors have been only sporadically successful. Now, all of a sudden, we are confronted with a great military, industrial, and civic obstacle. The un-Americanized immigrant can not be used effectively. He may even be a positive menace. The emergency thrusts the problem of Americani-

zation out into the forefront of our national life. The Secretary of the Interior, seeing its gravity, called a Conference on Americanization in April, 1918, which was attended by distinguished public leaders from all over the country. The Conference urged Congress to make a special appropriation to the Bureau of Education for an Americanization campaign. The money was not forthcoming from that source, but the bureau has since enlisted outside voluntary aid and is now organizing what it calls its War Work Extension, which involves a program of adult education for the foreign born.

To use a current commercial phrase, the bureau has recently "sold" two exceedingly galvanic ideas. The first of these is the idea of the effectiveness of community organization through the schools. The idea is not new. The time has simply arrived to put it into practical operation. For months the publicity offices of the government which wished to educate the public mind in the small and remote communities on such questions as American and German war aims, conservation, and liberty loans, sought a point of contact in vain. The admirably conceived propaganda of the Committee on Public Information frequently failed to reach its mark. The Bureau of Education then came forward with the proposal "Why not use the schools? Here is a chance for the community center really to function, because it has a definite, clean-cut task to perform." The State Councils Section of the Council of National Defense caught the force of the suggestion at once. In coöperation with the bureau it has entered upon a general plan for the development of community councils, which are nothing in the world but the organization of all the people in a school district using the schoolhouse as a meeting place. The bureau has also facilitated communication with all these centers by preparing for the use of any government office an addressograph mailing list of 300,000 separate school buildings in the United States.

The other idea which the bureau has put into operation is, I am inclined to think, the most concrete of its contributions to the war. It secured $50,000 of the President's fund for

the organization of the United States School Garden Army. The name sufficiently defines the organization. Day before yesterday the director of this work put into my hands a brief report of the accomplishments to date. These are the significant items:

"A million and a half boys and girls have responded to the call of the President and enlisted in the United States School Garden Army. Twenty thousand acres of unproductive home and vacant lots have been converted into productive land. This will release an equal acreage now used in truck gardening for the production of other food stuffs more important for war purposes. It will also relieve transportation congestion through home consumption of home-produced food stuffs. Fifty thousand teachers have received valuable instruction in gardening through the garden leaflets, written by experts in the bureau and distributed from there. A million and a half leaflets have been sent out."

It would be hard to overestimate the educational value, to say nothing of the commercial value, of this work. A million and a half children have been given a definite patriotic service to perform, under conditions which develop their sense of responsibility. I think it is a safe assumption that the United States School Garden Army will outlast the war.

Information and Publicity.

I have said that the Bureau of Education was established primarily as an information office. The assembling and furnishing to the country of reliable information on educational matters remains, after all, its basic function. An ever-mounting flood of publications issues from it. They relate to every conceivable subject. Some of them are interesting. Of course, no one person reads them all, except the editor of the bureau, and I am not sure that he does it from choice. But they find their separate ways into different parts of this and other countries and into the hands of those persons who can best appreciate the subtle beauties of each. These docu-

ments are produced in divers ways, but mostly by inflicting an inquiry on long-suffering recording officers, and I take this opportunity to say to any such who may be within hearing, that we appreciate both their sufferings and their cordial response. It has been necessary this year to send a number of special and, I regret to say, long questionnaires. The reasons are patent, and I expect we need not apologize. Every one wants to know how the war has affected educational institutions and what adjustments have been made. Consequently, we have sought to find out, for example, what has been the decline in enrollments, what percentage of instructors have gone into the military service, what changes have been made in academic calendars, what special war courses have been introduced, what deficits have resulted from the operation of the first year of the war, etc. One of the most extensive of our inquiries, made at the request of the Secretary of the Interior, called for an accurate estimate of the trade-training facilities of engineering schools and secondary schools. The returns (which were tabulated but not published) proved to be of invaluable assistance to the War Department in the recent organization of the training centers under the Committee on Education and Special Training.

Generally, of course, the material derived from inquiries and also the results of special studies made without resort to questionnaires are published as promptly as possible. Certain of these publications constitute very definite war service. May I call your attention to a few of them? Through the summer and autumn of 1917 the bureau issued a series of Lessons in Community and National Life, designed to present, for the use of secondary schools, the economic and political facts which are of special significance, in view of America's participation in the war. Over four million copies of these have been sold.

Future historians will doubtless be impressed by the astounding multiplication in one short year of agencies for promoting patriotic education. School officers were absolutely bewildered by the multitude of counsels and appeals. The

Bureau of Education was looked to for enlightenment. Which patriotic education societies really had a message? How should a principal or superintendent proceed to do his duty in the matter of providing education in patriotism? Accordingly we undertook a study of the situation, and published in April a synopsis of the agencies at work in this field, together with a selected bibliography.

But, after all, higher institutions have been most affected by the war and have made the most noteworthy contributions. Both for the purpose of preserving an historical record of their problems and their services, and for the information of college officers seeking new avenues of service, it is important that a current account of the work of American higher institutions should be furnished. On the eighth of May last year the bureau began to publish a series of Higher Education Circulars, under the general title of "The Work of American Colleges and Universities during the War." Thus far ten numbers have been issued. They deal with such subjects as the activities of national committees and associations, the problems of scientific and technical education, the actual war services of individual institutions, the effects of the war on foreign institutions, on the enrollments of American institutions, and upon university finance in the United States.

This statement is a very brief and incomplete outline of a very large and miscellaneous task. I am not sure that the bureau's true relation to the war emergency has as yet been determined. Were it to concentrate its efforts on any one of the fields I have mentioned, it would probably find more to do than could be accomplished with its insignificant appropriations. Actually it has had little opportunity for self-determination. Certain services have been urgently demanded of it by the school men of the country and by the departmental offices in Washington. It has done its best to meet these demands, to keep its head, and to help the educational forces of the United States to keep theirs.

OPERATION OF THE COMMITTEE ON EDUCATION AND SPECIAL TRAINING.

BY C. R. DOOLEY,

Education Director.

The only way to thoroughly appreciate the work of the committee is to visit some of the schools. The impressions you will get from such a visit will so far surpass anything that can be said here this afternoon, that I will give you only the briefest comment.

One hundred and thirty-six schools are now in operation or soon will be, representing every State in the Union except Connecticut and Wyoming, so that you will have abundant opportunity to see these things for yourself and catch the spirit which is rapidly shaping a new educational ideal.

The committee was appointed about the middle of February. Fundamental plans were pretty well blocked out and some scouting done during March. During the first few days of April a definite working organization was started and on April 10 the first soldiers were placed in school. This was less than three months ago. We have already graduated nearly seven thousand men; have now in training nearly thirty-five thousand; thirty-seven thousand more will enter within the next few weeks, and negotiations for still another twenty-six thousand are now being arranged for early fall; a total of one hundred and five thousand to be trained by November 15, fifteen thousand more than the original estimate.

Obviously no single organization, especially a brand new one, could accomplish such a task single-handed. By far the greater part of the credit belongs to the responsive spirit found among the schools and colleges of the country without exception. During the first weeks every mail brought scores of

telegrams and letters begging to be considered. Our district educational directors and inspectors were kept jumping day and night reviewing new situations and arranging details of contracts. Many details had to be settled without the slightest experience for a background, but never once did an institution hesitate to take a chance with this opportunity to serve. Even yet, every week brings some similar requests, almost begging to be considered. Schools with absolutely no experience in feeding large numbers of people undertook this part of the task, without the slightest hesitation. Others with no adequate facilities to house the men immediately erected barracks, in many cases borrowing the money over individual signatures, to carry on the work.

As the first quota of men began to arrive numerous unforseen conditions had to be met, and the spirit with which the institutions contributed additional services and facilities without question, and without thought of specific remuneration, is one of the highest tributes to our educational system. Whatever faults our various educational organizations may have, they at least, have shown that they are willing and able to meet a heroic emergency.

From a purely military point of view, the schools have been a success from the very start. The officers in command are continually commenting upon the excellence of form the men are attaining in remarkably short time. From this there would seem to be some complementary relationship between technical training and military form—each helping the other. Stories of community and municipal interest could be told by the hour, so that the mere establishing of one hundred and thirty-six training centers has brought the whole army program nearer to the people.

Every school has its unusual feature, and it seems unfair not to mention all of them at this time, and yet a few examples will illustrate sufficiently, I hope, to cause every member present this afternoon, to visit at least one school before returning home from the convention.

In Toledo all conditions were favorable excepting the hous-

ing. Acting almost upon impulse the matter was presented to the board of trustees and then to the city council, with the result that $25,000 was appropriated and barracks, mess hall and an instruction laboratory were built within twenty-six days.

In Rochester the city appropriated the use of $126,000 for this work.

In Indianapolis the public enthusiasm expressed itself through the chamber of commerce, which has been developing all possible facilities of the city, now totaling a capacity of fourteen hundred men. Dozens of college presidents and hundreds of instructors will forego their vacations this summer with scarcely a thought. Even Virginia with her dignified traditions of Thomas Jefferson and Poe has constructed a barracks on her campus, and is training automobile mechanics most enthusiastically.

But I think the most inspiring enthusiasm is that which expressed itself more quietly through the instructor who was until recently a mechanic in some automobile repair shop. The simplest question will start him talking, and you find his greatest interest lies in sizing up his men, helping each one to achieve the most that he can within the time available.

Of course, to those of us who have endeavored to guide the educational ideal back of the whole movement, the results of certain methods of training have been of greatest interest, and to illustrate I will quote from a conversation with Professor Hewitt, of New Hampshire State College, with whom I spent an hour last week:

"We have two faculty meetings a day,—twenty minutes before work and twenty minutes after work. In the morning each chief instructor explains the important phases of his work for the day. This allows for complete correlation, as for example, if the boss carpenter has a carload of lumber to move, the boss truck driver uses this opportunity as a part of the driving instruction. Barracks are being built for winter use. The carpenter soldiers are doing the woodwork, and the

concrete men are putting in the foundations. The blacksmith men are doing all of the repair work in connection with automobile repair. Automobiles are being sent from miles around for repair. There are no formal classes, each instructor supervises his men to see that they thoroughly understand the principles underlying their jobs. Any time a group of men is having trouble with a common point, the group is stopped and the point discussed, which may be a matter of ten minutes or an hour. In the evening, the instructors check up the important results of the day's work. From morning to night the atmosphere is that of a commercial job shop. From the president of the institution to the newest soldier, the object is accomplishment, and through all, the means of accomplishment is the careful study and analysis of methods. Each soldier in the construction of barracks at Durham has a complete set of blueprints. An hour in the evening is devoted to the voluntary discussion of these blueprints in small groups, largely the result of enthusiasm and interest among the men."

At Schenley High School in Pittsburgh, buckets, sheet metal elbows, cake pans, etc., are being made on a commercial basis, and disposed of to commercial firms. I picked up there, the other day, a complete set of drawings of a three-piece four-inch elbow made by a man who four weeks previous was a farmer, never having seen a drawing instrument in his life, and never having heard of the term "descriptive geometry." In fact, he does not yet know there is such a branch of mathematics. I also carried away the finished elbow, which is as good a job as any tinner would care to make. This illustrates perhaps one of the "pet" ideas of the committee, namely, that of selection before instruction. Therefore, while the contracts which we have with the various schools state definitely the kinds of training that shall be given to the numbers of men trained in each, we have made it clear that we do not expect the impossible, and that to train each man along a line for which he is by nature well adapted, is more important than to attempt to turn a definite fixed number of each specific trade.

Obviously this ideal can not be followed in minute detail, but with even four or five different trades, it is surprising to note the degree of adjustment that can be accomplished. Last week in Indianapolis I saw a piece of inlaid steel work, done so perfectly, merely by the aid of a file, that you could detect no crack between the pieces. The man who did it had been in the hospital until three days before, and had had no previous training.

If the degree of workmanship is not sufficient argument for preliminary selection, you have only to inquire among the men as to the real pleasure they are getting from their work. I have asked dozens of them, and have yet to find one uninterested, although there doubtless are some among so many thousands. We are just now finding out that the Old Testament juncture "Train up the child in the way he should go" was not intended to be interpreted as "Train up the child in the way you want him to go."

The most important single item in our executive organization, was the division of the United States into ten districts and the appointment of district educational directors, with headquarters in each district. Almost unlimited authority was given these directors, which greatly reduced the proverbial Washington "red tape."

Military inspectors were then sent into the territories, following the educational directors to close up formal contracts and check all military features of those institutions which had been approved.

For the first five weeks, reports came in thick and fast every day by telegraph, but now that the greatest part of the work of establishment has been done, the educational directors are turning their attention to helping the schools improve the efficiency of the instruction. The experience of the various schools as well as the general comments gathered from the various army corps, is being gathered in and will soon be published as instruction manuals. These manuals will be sufficiently definite to produce that degree of specialization re-

quired by the Army, but, on the other hand, they will be sufficiently flexible to provide for the broader development of resourcefulness and initiative without which the extreme specialist is greatly handicapped.

Results to be obtained will be set down rather than detailed methods, leaving the latter largely to the ingenuity of the local instructors. At the end of a course, each man is rated by listing the kinds of work he can do well rather than by a percentage grade of efficiency at which he can perform a definitely prescribed number of kinds of work.

A promotion program is preferable to a rotating one. It is not desirable to follow rigidly a program which provides that each student meets a definite length of time on each of a number of subjects in rotation. To illustrate: in the auto mechanics squad, only those men who have thoroughly mastered the details of the rear axle should progress to engine work and then again only those who show good understanding of engine construction should take up the study of gas engine performance. Again, only those who show special all-round ability in these things should take up the study of ignition, timing and the more complicated details of adjustment. Obviously an all-round mechanic is the most desired, but such a man can only be made out of all-round material, and all other material should be supplied according to its kind.

Such a promotion program is difficult to operate but a combination can be effected resulting in an omission of certain standard topics by certain men who have no capacity for these topics, in other words a short circuit can be provided for certain notches in the standard rotating program.

In order to provide for the development of originality, initiative and real thinking power and also to prevent a rule of thumb method, the teaching should be almost entirely through jobs, questions, problems and guided discussions about the work. Therefore, these outlines will contain hundreds of questions which will present to the men a clear picture of what they must learn. Further than this the learning

process is purely a matter of individual effort and strange as it may seem to some, the joy of individual accomplishment along with other causes is holding up this individual effort to an unusual high degree. In short, the educational ideal of our committee is that the accomplishment of the job is both the end to be obtained and the means for instruction.

WOMEN EMPLOYES—PLANO WORKS.

BY F. J. GERNANDT,

Superintendent Plano Plant, International Harvester Corporation.

To us at the Plano Works, West Pullman, it has been an interesting experience. About a year ago we started to put girls to work in our factory. The first job we put them on was to inspect parts for roller bearings. We previously had young men doing this work, sitting at a bench and measuring with micrometers. We needed the men for machine work and thought it was a good time and place to try out girls. We made it known among our men that we wanted a few girls; and if they had daughters, sisters or friends, we would be glad to take their applications. From that time on we have had no trouble getting female help. It will be of interest to you to know that to-day we have a waiting list of 250, all living in this district.

At first, the men were not accustomed to female labor, but in a short time the shop adapted itself to feminine help, and now they seem to treat it as a matter of course. Up to the present girls have not been placed on so-called dangerous tasks, where there is a chance of bodily injury; neither have they been placed where they would be subject to severe heat or cold. We have tried in every case to pick the woman for the job she is to do; and when interviewing applicants who are asking for work, we try, as far as possible, to class them according to age, past experience, type, nationality, health, physique, intelligence, cleanliness, education and general aptitude.

As we never employed women before in the factory and started slowly, it has given us a good opportunity to reëstablish the personal touch between the employes and the office, which so often gets away from us in a large works. I make it my business to go through every department where girls

are employed and examine their work, taking a personal interest in their working conditions and earnings; and do not hesitate to show them in every way that we think just as much of them as we do of the men.

On the whole, it is our observation that women are more attentive, show more interest in their work, and are anxious to make good on any job you give them.

A rest room and lounge room has been provided, furnished with chairs, reading table, lounges and magazines of various natures. The girls stop work ten minutes before the men, which prevents the mingling which is often objectionable to the women going out through the halls and stairways during the rush after the whistle blows. It also gives them an opportunity to get on the street cars before they are crowded; although, as I have mentioned, we try to hire mostly from this immediate locality.

It is true that women require more supervision, and the overhead, such as rest rooms, matron, etc., is greater for them than for men, but we feel that it does not overbalance the scale. The matron acts as a bumper between the foreman and subforeman and the women. We do not ask her to exercise any authority whatever in regard to the girl's work. To make myself clear: If a girl does not work as steady as she should, comes in late, or spends too much time in the rest room, we expect the foreman and sub-foreman of the department to discipline the girl. The matron is primarily on the job to look after the girls' welfare. Of course, if the matron thinks the girls are not doing the proper thing, she would call the attention of the foreman and sub-foreman to such cases, but we do not expect her to enforce discipline of any kind. Her function is to get and keep the good will of all the girls and women in the factory; so they will always have someone to go to with their problems, whether they are matters occurring in the factory or in their private life. Our matron tells me that a man can swear, but a woman must have a cry to placate her.

In the inspection department they work out well on a class

of work where gauges and limits are already determined, and where it is not a case of judgment.

Of the first lot of nine girls that went to work in the inspection department, all are with us at present, with the exception of one, and she left to get married. With few exceptions, they have lost hardly any time this year; and last winter during the severe weather they came to work when many of the men did not. We put the girls into the same room with the men, but at one end. We have no fault to find with the quality or quantity of work they do; and after serving long enough to become proficient, we rate them the same as the previous workers on that particular class of work. Within their limits, which are mainly physically, they can do as much work as previously performed by men. A great many of the jobs performed were formerly done by young men or boys, who grew up with the job or machine and were really in a blind alley. The girls readily learned the use of micrometers and fluid gauges used in this type of work; and it was not long until we had replaced all the men with the exception of a floor inspector, whose duties include the supervision of the women inspectors. The girls are anxious to make good on any work you give them. After a few months of bench work and giving them a chance to become shop-wise, we tried them out on small grinding machines. This was done by boys, and being a steady grind it was hard to hold them down. These machines were in the room and close to where we had the girls on inspection work. The boys were taken off these machines one at a time and girls put in their places. On jobs of this nature they worked out to good advantage. The girls have taken to this work nicely. We have comfortable stools and favorable working conditions, and they earn more than the boys did, simply by sticking to the job. The floor inspector oversees the work and the sub-foreman adjusts and sets up the machines. This was also done for the boys.

The girls, at first, were reluctant to try machine work, but when they found out by experience that they could earn more on a machine than on a bench, we had no trouble to induce

them to try machine work. The work is all light and adapts itself nicely to female labor.

We also have girls on packing and counting, running drill presses and a girl timekeeper. While this is not new regarding the employment of women, yet, to us, it is a case of where men did every job previously; and I might say, this same applies to all the other departments.

In the department where we make magnetos there is a great variety of bench and machine work. The girls in this department become very apt and as there are a large variety of pieces and operations, the work is of such a nature that we can change them about often, and place them on such jobs that they are naturally fitted for. In this department, we have girls running lathes, milling machines, punch presses, grinders and drill presses.

In the tractor department there are girls employed at present assembling small parts, packing tool boxes, using soldering irons, riveting, inspecting radiators, etc. These girls can use a hammer about as well as a man, and were put on these jobs with special attention to their strength, although we make it a practice never to require a girl to lift more than twenty-five pounds at one time.

In the paint department girls are doing brush work, stenciling, pasting labels, striping, and in fact, they are doing the work of a man wherever their strength will permit.

In the machine shop, on account of the weight of the material handled, we are placing girls on drill presses only, at this time.

In our chain department, where we make a heavy steel chain for the tractors, we are employing women altogether, with the exception of the trucking and heavy lifting. This is due to the fact that this equipment is all practically automatic, or semi-automatic, and being a late development at this plant, was designed with the idea in view that it would be strictly a department for girls and women, including the janitor work. I might take this occasion to say that on all machines it has been our practice for years to make them as

safe as possible and practically fool-proof, and we have had no accidents whatever from girls running a machine. In one instance a girl tried to show another girl how to pick a piece out of a machine and deliberately stuck her finger into a cutter and got a rather severe cut; but in this case the girl was not operating the machine, nor did she have any business showing the other girl what to do or what not to do.

Through the various departments we have girls inspecting. They inspect the various parts before they are assembled, and after they are assembled. In the machine shop they inspect such castings that are not assembled into any particular unit in the department, but go directly to the paint and packing departments. Such castings must all be thoroughly inspected, as there is no opportunity to catch mistakes after they leave the department. The girls and women look these over carefully, trying the gauges if there are any little defects which can be remedied by a little filing or fitting—they take care of these small jobs.

We had quite a number of men as timekeepers and office help, and as they are now leaving we are replacing them by girls. We find no difficulty whatever with the girls acting as timekeepers out in the departments where there is mixed help.

One thing which we are trying to do, is to standardize all clothing for the women in the factory. Overalls, or overettes, are being introduced, and some of the girls are wearing them. We believe that if all the girls are dressed alike, that there will be less rivalry as to dress, and probably less comments as to the matter of dressing. This is the information that the matron gives us.

We have not posted a single rule or regulation pertaining to girls or women which is not already incorporated in our regular factory rules; and about the only hard and fast unwritten rule which we have is: that there be no gossiping or quarreling. I am glad to say that if there has been a case of this nature, the matron has been able to take care of it without bringing it to the front office.

At the present time, especially in our departments where we employ skilled tradesmen, the younger men, where they have been placed in an exempt class of the draft, are leaving us to work in munition factories. As we are unable to get men to fill these positions, we are taking men who are exempt from the draft for various reasons, from the other departments, and placing them on machines and on jobs in the tool room, and training them to become proficient on this particular machine or job by appointing one of the tool room foremen as an instructor; and making it his duty to go from man to man all of the time, simply to teach these men to become proficient operators.

For instance: If we have a man in the machine shop who has been particularly apt on a simple class of lathe work, we take him into the tool room, put him on a lathe and train him to do tool room lathe work. If he turns out to be a good choice we keep him there, and he can eventually earn as much as a skilled lathe operator on tool room work. If, for any reason, he does not turn out suitable for this class of work, we train him in various operations on the lathe, so that we can turn him over to one of the manufacturing departments in which they have difficulty in picking up men accustomed to lathe work, and where the foreman cannot spare the time to instruct the men in the fundamentals.

This is the idea in general which we are carrying out, and we do not leave a machine idle nor a job wait because we are losing skilled men. We have adopted this method as the most practical way of taking care of our own present local conditions.

Eventually, it is my opinion that we will, perhaps, have to set apart a certain section of the shop, put in machinery, and under competent instructors run through various parts of our machine production; and train men and women in this way to keep our work shops full of machine operators and semi-skilled workers; taking such as show exceptional skill and giving them opportunities to develop into skilled operators. This seems to be the only solution under the present difficulties.

A TECHNICALLY PREPARED RESERVE TEACHING CORPS.

BY W. J. RISLEY,

Professor of Mathematics, James Millikin University.

I know how to quit in four minutes in a theater, but whether I can do the same here I don't know.

We have talked about efficiency in engineering instruction and the instructor being prepared technically to do his business and that is my aim.

I have among my past students three or four who are holding army instructional positions, two of whom are teaching gunnery, about which I know nothing. I know which end of the gun is supposed to have the shell in it and I know out of which end the shell is supposed to go toward Berlin, and I imagine that is about the sum total of gunnery knowledge in this room.

I think if my students can go to Norfolk and take coast artillery and become sufficiently expert to teach it when they have no more mathematical and physical equipment than we give them, that perhaps I might and you might in two months learn enough without technical foundation, so that when the time comes and these boys of Pershing's age are needed in that drive which must come before we complete our business in this war, the three- or four- or five-million army which must go may be sent to Millikin and Illinois and other places, or that we may be drafted into service, taking the place of these boys who may be useful in the active military service. Hence, I believe three or five hundred, a thousand, or fewer or more of us, who may be disqualified for military service abroad, might well be placed in these various schools where we might be able to absorb enough of this information that when the time comes, we as technically educated and trained

reserves, might be called upon whenever, in the judgment of the department, we should be conscripted to take the places of these men who are called into active duty.

Some one says, "Suppose the war is over before you get it done." Then I will have accumulated something which I will be pleased to hand back to Uncle Sam with good compound interest. I will have gained something that will make me a better instructor in the time to come. It is not lost.

One of my former students is an instructor in machine gun work at the University of Illinois. My oldest boy is a student in the ground school there. I know that student was sent from Columbus, Ohio, barracks, to Champaign for further orders. As soon as he arrived he was informed that he would be a machine gun instructor beginning three days later. He got his first book then on machine gun instruction. That is how much he knew about it. He had from Saturday to Monday morning to keep ahead of the youngsters.

I presented this matter of military instruction to Professor Mann and it has his hearty endorsement. I also have his instructions as to how to get it through when I want to write down to Washington. I present it to you for discussion and for such action as you may care to take.

Discussion.

Chas. S. Howe: Mr. President, I take it that the War Department is already considering matters of this kind. Eleven engineering institutions have been asked to nominate one professor each to go to Fort Monroe this summer to take a two months' course in gunnery. The greater part of the work is to be theoretical and the men are not to be in uniform. Some of the work will be practical work with the guns. We have just nominated our man to go there. I take it this is an opening step.

They say in their circular that it is important that gunnery be taught in the engineering institutions and that they are trying to see whether they cannot find members of the faculties to be taught enough gunnery to give courses to the stu-

dents and interest them in the coast artillery, which department of the Army has been making a very great effort to get our engineering graduates. I believe that before very long the War Department will extend this matter and will invite all of the engineering colleges to send members of their faculties to such schools.

C. Russ Richards: Apparently this Committee on Education is endeavoring to stop the competition of the different branches of the Army for technical men. Such action is a step towards the coördination of the needs of the Army and the apportionment of technical men to cover as nearly as possible such needs.

Of course, this is propaganda on the part of the coast artillery. They want instruction given to interest the best of the men in its branch of service.

President Howe: I take it that the institutions are going to send men down to Fort Monroe.

Dean Richards: We are going to.

T. U. Taylor: Mr. Chairman, we have had some experience with this method of recruiting raw instructors.

About seventy-five of my own ex-students are instructing in these ground schools or in similar schools, but the method does not consist of such procedure as the gentleman described who would lead us to believe that a student got there one morning and was going to instruct the next morning. These men are carefully selected after considerable investigation. They are brought there as instructors, but they do not go into the actual work for some weeks. They are put in classes first, and the government has been very careful in selecting them; they are not the raw products, but they have the foundation. They are already at least junior engineers and most of them are graduates. It is their technical training which is the foundation.

I was filled with fervor to get into one of these schools, but I was told they didn't want any men over thirty-five, so my patriotism had to have an outlet in making four-minute speeches.

W. T. Magruder: Mr. Chairman, the practice is to put these men in the classroom as students and as observers for two weeks, and also in the laboratories. They are graduates of schools, have practical experience, are twenty-five to thirty years of age, are engineering graduates with several years' experience in motor car work. I think the case Professor Risley mentions must have been an exception.

Mr. Risley: I have no intention of diverting the discussion. The point I want to make is whether or not we think it is a good idea for us to be put in some technical place as President Howe has said. What do you think of the proposition that we should offer ourselves to be placed in these positions where we may be technically trained? I have just used guns as an instance.

Professor Magruder: I might add another statement. We have a man at our aviation school who is an expert in gunnery, but being a civilian, he is to be replaced by order from Washington by a young instructor in gunnery. There is a difference between his being an old experienced man in the art of gunnery for many, many years and not wearing a uniform and the man who does wear a uniform.

Mr. Risley: Then you mean the government will hold to Army men?

Professor Magruder: Yes.

Mr. Risley: I should hold, then, Mr. Chairman, that the idea should still prevail. I am perfectly willing to be called an Army man. I am perfectly willing to have them take me. They can take my youngsters and my cash and they can take me. I think we should be prepared to do the job. I am willing to be an Army man and wear a uniform and do all that the uniform calls for.

WOMEN EMPLOYEES IN THE NATIONAL HARVESTER COMPANY.

BY HENRY G. COX.

Mr. Chairman, Ladies and Gentlemen: When I was a boy in Sunday-school I was very much exercised over what I considered to be the very raw deal handed to the children of Israel when they came out of Egypt. If you will remember, the children of Israel had a pretty tough time of it. They had a hard time, nearly got drowned in the Red Sea, nearly starved to death, nearly died of thirst, and then they were not permitted to go into the Promised Land until that generation had all died. I had to be a good many years of age before I realized that if those people had gone into the Promised Land they would have made another Egypt out of it.

We are now industrially in the position of the children of Israel, in that we have a promised land offered us of new shop methods and higher efficiency, because we are now employing girls who do not know our old methods and so can learn the newest ideas of work we have to offer them.

I am asked this question about girl labor: Are they dependable? Do they turn out as much work as men who formerly did the work they are now doing? By dependable I mean are they on the job as steadily as men, and in answer to that question I will say that girls will stay home for more trivial reasons than men will, but when they get their hearts into the work they hang on and are very conscientious.

In our plant we had to introduce the work on machine tools very gradually to the girls, for they were not used to doing that work and they feared the machine tools—feared bodily harm. As Mr. Gernandt said, we have tried to make our machines as safe as possible and we have found as great a variation in girls adapting themselves to machines as any

like number of boys. For instance, one girl who had been a waitress in a Thompson Restaurant (and you can imagine how quiet one of those restaurants is in the midst of the noon rush) could not stand to be in the shop but two hours; the noise and confusion was too much for her.

Those girls that have taken to the machines have shown us some remarkable results. They come with open minds and here is our opportunity to teach them. They have never known how to do lathe work or fine grinding where we work to one half of a thousandth of an inch, one sixth the diameter of one of the hairs of your head. They have never done that before in their lives and if we take a skilled man to teach these girls how to do it, they will keep right on doing it in that same way.

Mr. Gernandt referred to jobs where the girls do not have to use a great deal of judgment. It wouldn't be fair to take our girls who are of the same mental growth in machine shop work as apprentice boys would be and ask them to use the judgment of skilled men, men who had had long experience and gone past their apprenticeship, but one of the nice things is that they will do what we tell them to do and don't go off on a tantrum or exploring expedition of their own.

Now we have in a small way tried to teach these girls as in a school. It has been the habit of the foreman in the past to take a man and give him a job and say, "Do it," and he expected that man to do it. We don't expect these girls to know how to handle a lathe and so we teach them. As Mr. Gernandt has also said, we will probably have a school one of these days there to give them the best teaching we know how.

Let me show you what some of our exceptional girls have done on machine work, and by that I don't mean just running a drill-press. In running a big milling machine, milling a key-way in shafts, they have increased the production from six hundred per day to twelve hundred. In the reaming of bearings in magnetos they have increased the production per day from nine hundred to seventeen hundred; rough turning of bushings, nine hundred to sixteen hundred; turning

collecting rings on magneto armatures, three hundred and fifty to nine hundred; turning end caps, three hundred and fifty to one thousand; facing the ends of magneto frames on a lathe, four hundred to eleven hundred per day; turning bushings to length, five hundred to fifteen hundred per day. All this on piece work. That shows the possibilities of what can be done with woman labor, and we are very well pleased with the showing that they have made so far.

I thank you.

INDUSTRIAL RESEARCH.

BY JOHN R. BIBBINS,

Resident Engineer, B. J. Arnold Co., Chicago.

Mr. Chairman, Ladies and Gentlemen: The particular subject which has been assigned to me came to my notice on extremely short order, and I have not prepared, as I should have done to save you from poor delivery, an abstract of this subject.

A short time ago a group of engineering alumni of a large university took it upon themselves to investigate the subject of industrial research in which they seemed to be individually and collectively interested. The result of that investigation was so interesting that I have the temerity to place the essential facts before you.

A scientist of whom you probably have heard, Colonel J. J. Carty, of the American Telegraph and Telephone Company, devoted his entire presidential address to the American Institute of Electrical Engineers in 1916 to the subject of the relation of science to industrial research. I may say there never was a more enthusiastic man who combined the desirable features of the scientist and the engineer than Colonel Carty. Here are two paragraphs that convey his point of view:

"The investigator in pure science may be likened to the explorer who discovers new continents or islands or heights or unknown territory. He is continually seeking to extend the boundaries of knowledge.

"The investigator in industrial research may be compared to the pioneers who survey the newly discovered territory in the endeavor to locate its mineral resources, determine the extent of its forests and the location of its arable land, and

who in other ways precede the settlers and prepare for their occupation of the new country."

Dr. Robert S. Woodward, president of the Carnegie Institution, personally contributed to this investigation I speak of and he wrote a very pertinent section:

"As a nation, however, we shall be in peril in competition with other nations if we provide no facilities for the generation of men who not only possess knowledge but who can acquire new knowledge. Thus, while I would consider this second desideratum in an engineering school not so practicable of easy achievement as the other, I would regard it as of much greater importance to the future of the university and of our country."

He was addressing himself to industrial research.

In today's mail came the report of Dr. Hale, president of the National Research Council, and while I have not had a chance to read it in detail I find it presents in a most extraordinary fashion the tremendous activity going on in this particular field of industrial research, and it is quite apparent that the subject has awakened so much interest that even the daily papers quite recently (the *Chicago Tribune* and the *New York Times*) have been continually hammering at this question of industrial research after the war.

Dr. Hale's report closes with the personnel of an Advisory Committee which is just forming, containing such men as Elihu Root, Theodore N. Vail, Dr. Pritchett of the Carnegie Foundation, George Eastman of the Eastman Kodak Company, Mr. Du Pont of the Du Pont de Nemours Powder Company, Mr. Mellon of the Mellon Institute, Mr. Dodge of the Phelps-Dodge Company and Mr. Swasey of Warner and Swasey Company.

Any one who has spent years or even months of his engineering days in watching the processes in industries, if he is at all a student, is profoundly convinced with the necessity of research.

Quite recently I took my lame automobile to a magneto manufacturer to have the magneto fixed. I inquired what

would necessarily have to be done to it. They replied that they would take it to their research department. When I went back a solemn individual came out and said the magneto needed remagnetizing which would cost me $5.55.

The essential idea of this plan we have been working on, for which we claim no novelty at all, is that in every state or district there exists a large number of industries, only a few of which have the technical ability on their staffs or, in fact, the money to support a laboratory for the working out of its technical problems. It seemed, therefore, that inasmuch as the universities, especially the large state universities and certain of the private universities and technical schools, were already doing so much work along technical lines, that it would be advisable to broaden out the work in the scope of these schools and endeavor to reach closely these industries which contribute indirectly to the support of the universities through taxation. By so doing there would be formed an industrial pyramid, the base of which would rest upon the industry scattered over the state, and the apex of which would reside in the collective brains of the possible graduates and teaching staff at the university.

The peculiar ethical question arising in connection with this matter of research relates to the disposition of the results by the results of the research, especially where an industry has provided money with which the research is to be made.

There is a rather strange fact in connection with this investigation. It is that one of the largest institutions in the country, especially relating to this engineering department, had not yet endowed one single scholarship for technical research. That was a thing that we found it difficult to understand. It should be said, however, that various institutions have contributed, and some of them have contributed liberally, to the establishment of scholarship for certain specific things.

Now the important part of this investigation was never touched as we carried it out. The developments of the recent two or three years, however, have shown that the idea should bear fruit rapidly.

I was very much impressed with the statement made by Professor Mann in regard to taking back the young engineers to complete their work. It is absolutely in line with a letter I received from a Canadian Government officer in which he stated that the Canadian Government made the terrible mistake of allowing all of its engineers that wanted to go to war and enlist to so enlist at the beginning. As a result they were not able to bring those men back, and they found great difficulty in supplying their places, and finally the rigid order went forth that engineers should not be allowed to enlist until their education was completed.

Quite recently the British Government has organized and promulgated a Research Bureau which has the backing of the government and all the scientific societies for the coördination of the research work.

The German Government has also set on foot plans for the coördination of research work in various departments. The character of this is particularly ominous because the legislative branches of the government—senators and representatives—are directly involved and form the personnel of this ironclad combination of research agents with the idea, of course, of holding all of the effect of that research work in the hands of the German Government for the purpose of competition with this country when the war is over.

I say that it is quite obvious in many respects that this country will be at the mercy of forces with which it will not be able to compete if this matter of industrial research is not more thoroughly recognized and worked out, and it can not be done unless the line of work is drawn between the laboratory and the industries. That is the important thing I wanted to convey.

Discussion.

A. S. Baldwin: After the very practical illustrations of what is actually being done in large institutions in the way of coördinating working system with the educational system, I am afraid I can add but very little from my experience on this.

The railroads, as a rule, have not been in a position to carry on a really coöperative arrangement with their employees to aid them in getting an education. Their activities are generally scattered over too wide a field, and while it is true that something has been done in the shops in many places, there has not been a great deal done in that line in the way of promoting a general education of employees.

We have in one of the shops of the Illinois Central Railroad in a small southern city done something along that line. An arrangement for helping young men get through high school has been worked out in a very satisfactory way. Two young fellows desirous of finishing their high school courses and at the same time getting practical experience and maintaining themselves will go to the superintendent of the shops, this coöperative arrangement having been worked out between the superintendent of shops and the superintendents of the schools, and will sign up as one apprentice. Then these two young fellows work alternately between school and shop, one of them spending a day in the shop while the other is in school and the next day the one who was in school spending his time in the shop while the other one goes to school. They can get together at night and study, each helping the other in the particular line in which he has had experience during the day.

That has resulted in quite a number of men being put through high school in a very practical way, getting their living while being put through the school and getting a very valuable knowledge in mechanical work.

Will it not be possible to carry that further in the relationship of the universities to those men who have gone beyond the high school age?

We are bound to recognize the fact that no steps that can be taken now, in my judgment, are going to supply the requirements for educated men in engineering pursuits within a comparatively few years. The demand for engineers, it seems to me, will be enormous. The requirements in the foreign countries that have been devastated will be great. Enor-

mous numbers of industries have been developed, all requiring the work of technically trained and educated men.

The lower ranks may be filled by an expansion of the manual training school idea and the correspondence schools, but if we are to look at the subject from the standpoint of true Americanism in giving every one of those who enter, before they get or complete their technical education, an opportunity to do so, it seems to me that some arrangement could be worked out and must be worked out by which the universities will go to the men as long as the men cannot go to the universities. Possibly it can be done by the establishment of branch schools in different parts and centers of the states for the state universities which will carry men along who are engaged in work, so as to enable them to get their degrees and get the technical training they should have in a comparatively short time.

In other words, this must be exceedingly general in manner, and if the state universities are designed to be general in their scope of education, it seems to me that they can well afford to try to work a system of this kind just as some of the state universities have worked out a system through which any resident of the state can take an academic degree by going to the university and passing the required examination.

If, however, it is to be done really successfully and not simply in a comparatively few cases, but in all, I believe it must be something more than an entirely voluntary arrangement. I believe there must be to a certain extent an enforced cooperation between the employers, the employees and the universities, and that the employers must be willing to set aside a certain specified time each day for their employees to get the benefit of additional education by which they will undoubtedly be greatly advantaged, and the universities representing the state must avail themselves of those opportunities to broaden the knowledge of these men.

As regards the service of engineering students in the Army, that is, the military service, that seems to me to be the most important part. It has not been dealt with or dwelt upon to

quite the extent that it might have been, and that is the exceedingly small percentage in point of numbers of those who are taking technical education as compared with the numbers who are to make up the Army. Take all of the engineering students out of the Army today and in point of numbers you would not lose a large number or force of men, but consider what the potentialities of those men will be if they are allowed to finish their education and go forth into the world to do the service that they will be so much needed for after the war when the ranks of engineers have been so greatly depleted.

If there is any one present who would like to ask any questions regarding any subjects spoken upon tonight, I am quite sure we will be glad to have discussion, if not, the meeting will stand adjourned. I thank you for your attention.

THE NEEDS OF THE NAVY.

BY LIEUTENANT B. O. WILLS,

Supervisor of the Officers' Training Schools for the U. S. Naval Auxiliary Reserve.

When I heard of this engineering meeting out here, I was very anxious to attend it just to see how much the men knew about the Navy and to see how they were attending to our end of the game.

It seems to me the Navy is not anything like the Army; it is not that much in size, and we don't know whether everybody realizes that the Navy, although small, is working hard and has a big part to play in this war, especially as we have just started this engineering school. It has only been in operation now since about March. The reason we started it was because we saw that the engineering material throughout the country is coming to a critical situation. We are taking over all the marine engineers and bringing them into service.

With the amount of shipping that is going to be turned out in the next year we can't possibly have enough engineer officers for all the ships. We have to have shipping to win the war. If we don't get that shipping across the ocean, we can't win the war. It is a pretty well-known fact that if the allied fleet remains intact there is no possible way for Germany to win in this struggle. The Allies can't win this war unless the American Army gets over there, and we can't get the American Army over there unless the fleet moves.

When you come right down to the important factor of moving a fleet, you find it is the engines, the machinery.

At the engineering school at Hoboken, New Jersey, we went after the technically trained men because their minds can be molded into efficiency and they will become engineer officers

as distinct from machinists. They have to soon become chief engineer officers. They can't go out and take the years to go up the ladder as they have in the past. They have to become chief engineers in a very short time. Therefore, we have to have the technically trained men to educate.

We are not so well off as the Army because it is a hard proposition to keep out of the Army, and in the Navy it is a pretty hard proposition to get into it. We are having quite a bit of difficulty right at the present time in getting our material, and that is not from lack of coöperation on the part of the colleges, but it is lack of efficient system of getting people into the work. True, our medical examinations are pretty severe, but we hope to have better coöperation on that score.

We want to bring the proposition to the student body. We want to bring all this data to the boys that are in the schools, to the mechanical and electrical engineers. They are going out into work that is absolutely in their line. There is nothing better for a mechanical or electrical engineer than to be right on board ship where he is operating the engines, has charge of the dynamos and the entire system. One can get more training in that way, and it is more interesting work than almost any work a man can go into. At the end of his time on the ship the boy has a profession and is right in the work for which he studied at college, and whether he wanted to get along as fast as he has or not, he is made to be an operating engineer very soon. He has to become an operating engineer; we won't let him become anything else.

When a person goes out and knows he has something to do he will do it. The American boy today is the type that takes responsibility when you give it to him.

There is, of course, the other field for the deck officers. In our deck officer schools we are turning out two hundred and fifty graduates a month and over one hundred engineer officers, but next year we hope to turn out over five hundred deck officers a month and about two hundred engineer officers a month. There is a field there and we just have to

appeal to the college men who think that they don't want to be in this kind of work. They can enroll as second class seamen and continue their college training; then when they go through college and graduate they are eligible at that time to have their ratings changed to machinists' mates. Almost any man who is determined will get where he is going.

I am going to have a system about this training so that I will know almost everybody that is enrolled with a college degree, and I will try to work it from our end of the game to get the college men there for the work.

It is a great deal better for a man to continue two or three years in college when he knows he can go on into an engineering school which specializes him for engineering work. After that he can get his commission, go right on up and have responsibility in a few years instead of going in by enrolling and becoming a seaman and thereby taking two or three years to climb up the ladder. It is the education that counts, and we have to make the boys understand that.

What Dr. Mann has just said in regard to the Committee in Washington is all news to me. It pleased me very much to know that there is a Committee which is not turning everything towards the Army but has an interest in the Navy.

REPORT OF THE JOINT COMMITTEE ON ENGINEERING EDUCATION.

BY C. R. MANN.

Mr. Chairman and Gentlemen: Four years ago at the Princeton meeting I first appeared before this Society and discussed the possibilities of a report on engineering education. It is appropriate that the final report on the subject should be presented here at Evanston, because, when appointed to undertake this study, I was at the University of Chicago, and the problem was entirely new to me and outside of my then work. I there made tracks as fast as I could to the nearest source of enlightenment upon this subject—Director Hayford, of Northwestern—and the first formulation of the outlines of this study were made in two long sessions in the director's office upstairs. Along the general lines there discussed, the work has proceeded for the past four years.

I was very much interested last evening to hear Director Hayford's statement of the ideals of this school of engineering. There were two things in his remarks with which I wish to take immediate exception. He stated that the ideal of the engineering college here is the thorough training of the engineer both in science and on the humanistic side so he should be an all around man, capable of carrying on his profession successfully, not only in the two or three years after his graduation, but for the next forty years of his life.

That is an ideal with which we all agree. He stated, however, that the policy of this school was to keep the men here for five years while the policy of the country has turned to an intensive training which is much shorter; and, therefore, he said the ideals of this college had to be held in abeyance for the next few years, but he hoped to revise them after the war. Those last two points are the points on which I do not share

Director Hayford's view. I do not share the view he takes that these ideals are in abeyance in the slightest degree during the war, nor do I agree that it takes five years to develop a man of the type that we all want to see developed. In fact, this crisis in which we now find ourselves is the time when the engineering profession should show the schools how to develop themselves so that they can accomplish the desired result in a very much less time than has usually been supposed to be required. It is perfectly obvious to any one who is familiar with college education that we have never put an adequate amount of steam into our college studies.

The reorganization of education so that the students have more steam,—so that they go to work with the same spirit that they go to foot ball games,—is essentially an engineering problem; and I believe that this association at this time can safely follow the advice given by Mr. Baker last night, and undertake to develop a new type of engineering education which will accomplish the ideals which Mr. Hayford mentioned last night. It is an engineering problem.

You remember Watt's first engine was a ten-horsepower engine. He set it up in a factory at Manchester to test it. A large crowd assembled and Watt himself wrote of the occasion: "The crowd was enormously impressed with the magnitude of the engine and with the awful noise it made." Now that engine consumed ten pounds of coal per horsepower hour. Ten horsepower,—enormous wheels going around with great ostentation and awful noise accompanied the display of the engine. At present in the power plants we see a large round cylinder and hear a gentle hum, and there is five—seven—eight thousand horsepower being developed at one pound of coal per horsepower hour. The conversion from the one to the other has been an engineering problem.

We have an analogous condition in the schools. We are ostentatious, the wheels are going around, there is a great deal of noise; yet too much energy is escaping through the safety valve in shouts and steam on the football field.

The report is now finished. The proof was sent to the com-

mittee about the middle of April. There are one hundred and twenty-five pages. After the Joint Committee on Engineering Education had this for about five weeks, they held a meeting in New York on May 24, at which they voted to approve the report as it was with a few minor changes. Those minor changes were incorporated and the document is now ready to be printed. It was, however, felt very desirable to preface the report with a suitable introduction by the committee, stating the history of the movement and giving an explanation of the particular ideas or particular lines of activity which the committee feels the report is well calculated to stimulate. That introduction has been written and is being circulated among the members of the committee. When it is finally approved, a brief introductory note will be written. As soon as these introductions are in proper shape the report will be issued.

It has been arranged that the members of this Society will all receive copies as soon as it is off the press. I am sorry to say it will take some weeks, certainly not later than the first of September, before it will finally be in your hands in finished form.

It has taken so long to prepare this report—four years since I began work—for several reasons. The chief reason is that during these four years the engineering profession has radically changed its own views as to what engineers are for and what their particular problem is. Of course, it was useless to issue a report that would merely describe the situation as it was then and would not point out any direct road of progress that would be useful for the next ten or fifteen years.

In the second place, the report as first written was too long. It would have filled some two hundred and fifty pages of print. Dr. Pritchett felt it was much better to shorten it and make it more direct. Therefore it was rewritten as reported last summer at the meeting in Washington. Since then it has been completely rewritten again and has finally been reduced to one hundred and twenty-five pages, which any one can read in an afternoon and then digest at his leisure.

The report is divided into three parts,—like "All Gaul." The first portion deals with present conditions. It treats of the development of the engineering schools in the United States, their early history and the aims and curricula of the early schools. It shows how Rensselaer, for instance, built up its first curriculum, where it got its money, how the Massachusetts Institute of Technology curriculum was established. It points out the close resemblance between the early curriculum of Massachusetts Institute of Technology and that at Rensselaer, and calls attention to the fact that the Rensselaer curriculum was imported from France. It deals with the struggles for recognition and the obstacles the engineering schools had to overcome because of the failure of the professional engineer to recognize that engineers could be trained in school. Up to that time engineers had been merely trained by the apprenticeship method.

It deals with the changes of curricula from the beginning to the present time and discusses their content and the distribution of time among the various courses. It discusses the methods of administration in engineering schools, faculty control, student elimination and progress. Much of this material has already been presented to this Society as to the percentage of students that are eliminated and the percentage of low grades in various subjects. It then takes up types of instruction in engineering schools, and indicates briefly some of the common practices in teaching the standard or fundamental subjects such as physics, mathematics, chemistry and English. That first part is an attempt to state what present practices and conditions are, and to describe the situation that needs analysis.

The second part tries to analyze this situation into separate distinct problems. It is called "The Problems of Engineering Education." The first chapter deals with the problem of admission,—what the present practices are, how the present practices have developed, what questions are being considered now by the schools in reference to their entrance systems, what experiments are being made,—and it attempts to dem-

onstrate that the development of entrance requirements in the past fifteen years has been away from the control of individual judgment in deciding whether a boy is fit for college or not and toward a system of committee control. The College Entrance Examination Board, as you know, was organized to do away with this individualism in college entrance examinations,—where the professor gave his own examinations and made his own decisions as to whether the boy was fit to go to college or not. This was a step away from reliance upon the personal judgment and bias of individuals and toward entrance tests upon which all individuals will agree; that is, objective tests. In order to indicate how such tests could be developed, and what reliance could be placed on them, a series of experiments were made for the Carnegie Foundation by Professor Thorndike of Columbia University. These experiments are described in the appendix.

The second problem is called "The Time Schedule." Attention is here directed to the fact that the current practice in making curricula is for the faculty to discuss only how much time shall be allotted to each particular subject. As you all know, the Committee on Curricula, or something of that sort, meets, draws up a schedule and says, "We will give five hours a week Freshman year to mathematics, five hours in chemistry, three hours in English, etc.," and having determined the time schedule, they turn this allotment of time over to the department and in general allow each department to do whatever it likes with its time.

So far, little effort has been made to reverse that process and determine what information and ability in mathematics an engineer must have and how much time it takes to train the average of the class to that degree of skill in mathematics; and then to allot that time to the mathematics department. Little progress has yet been made in experimenting,—for a lot of experimenting is necessary to find out the answer to the question: "What mathematics must every engineer have thoroughly mastered and how much time does it take to teach that to a reasonably intelligent youth?"

The content of courses is the next main problem—"What shall we include in the different courses?" This needs no further explanation.

Testing and grading is the next problem. It is here pointed out that current methods of testing and grading in college are like entrance examinations still subject to the fallacies of individual judgment because every department certainly, if not every individual professor, sets its own examination papers and passes its own judgments. Under those conditions a test is apt to measure more how much a student has conformed to certain points of view of the department rather than to measure his real ability in handling the particular subject. So the question is raised: "How shall we conduct testing and grading so as to make it a real test of the students' ability to handle the material they are supposed to handle because of their participation in that course?"

It is pointed out that a real test of ability, which is objective in the sense that everybody must agree to the finding of the test, is an enormous incentive to a student. It releases his energy to achieve the best that is in him. Such a test is everywhere used in athletic work, because if a man runs the hundred yard dash in ten seconds or eleven seconds, whatever it is, everybody can measure the time and determine accurately and objectively whether he has achieved what he should achieve or not.

At present there is very little such testing in college work. If we can devise tests that are real measures of achievement so that the boy feels when he has received "A" or "B," that this measures his real ability, you have in your hands a weapon of enormous power for releasing the boy's energy and aspiration to achievement.

The next main problem is the shop-work. This is analyzed in this way: There are a number of types of shop-work. One general type merely sends the boy out to observe what is going on in shops. That was the original type at Rensselaer back in 1824. It is still carried on in a very effective manner at Yale. There they have ten days in the junior year when the class

comes together and is taken through certain shops and shown certain particular operations in practice; then they go back and discuss these and are told about what they are going to see the next day. The next day they see other shops, observe other practices, discuss them and write reports. This practice has a large value. It is very much like the shop excursions to visit industrial plants.

The shop-work that is given at Worcester is of another kind which began with the founding of the Washburn shops back in 1868. The idea here is that it is essential that shop-work have a direct commercial value,—that the boys build something salable, and that the test of the shop-work is its salability in the open market. This is an objective test. The shop-work is still conducted on this basis at Worcester. The boys are given certain exercises to develop skill, and then produce drill-presses and other machines which are sold in the open market. I believe Rose Polytechnic Institute runs its shop on the same basis.

The idea of connecting production with the shop-work and making the production methods an essential part of shop-work has received different treatment at the University of Illinois, where they call the shop a shop laboratory. They manufacture a two-cylinder gas engine in a shop that is organized as if it were a real producing plant. It has its planning department, its specifications for every job and its tool room. The boys take turns in passing from one division to another and thus get experience in all operations of the shop. It is run on a scientific management basis, and incidentally the students get some skill with machinery and tool work by carrying out exercises that are specified in the same detail as would be the case in a regular plant. The idea is to make the shop a laboratory in which to demonstrate to the student how to run a production plant scientifically. The students work with great enthusiasm and there is a real objective test there because the different squads of students are rival teams. They have to get their jobs done in a specified time and they rival one another as on the foot ball field. There is real snap in it.

The other type of shop-work, which is the common one in most of the schools, was started by the Massachusetts Institute of Technology in 1876. President Runkle went to the Centennial Exposition and saw samples of the Russian system of shop-work, in which production was entirely divorced from construction. Production processes were analyzed in the fundamental shop operations of filing, chipping, boring, etc., and each boy was made skilful in each of these operations. Having learned these physical manipulations, he was supposed to get his construction experience after he graduated. That is the type of shop-work that is now found in most of the engineering schools.

There is one other type of shop-work and that is the type at Cincinnati, where the boys spend half of their time in a real shop, doing real production work for real pay, and the other half in school, discussing the problems which they have discovered in the shop. This Cincinnati plan, I find, is usually conceded to be a plan to get familiarity and experience with industrial shop-work and the general prevailing opinion seems to be that it is a very good plan for producing mechanics—high-grade mechanics—but it is not the scheme to be used for developing the type of engineer we all want to see developed.

It is perfectly obvious, of course, that no school has yet achieved the ideal, but the underlying notion in the Cincinnati plan is that real production work,—industrial practice,—is the source of all engineering problems; and, therefore, a man is best trained to solve engineering problems by practice in solving such problems. Hence the student should be taught in the shop to find problems and to bring them out of industry back to the school to be solved theoretically there. This idea has been developed still further at Cincinnati until at present certain of the students in the junior and senior years no longer work in industrial plants at industrial jobs but work in the research laboratories of those plants.

The process of selection on the basis of—"Can the boy see the problem in the physical situation; can he take that problem back and solve it?" is one that picks out the men who

have the research ability. At present a number of the Cincinnati students are working in the Dayton laboratories as research assistants in electrical lines and these are found to make extraordinarily satisfactory research men; so that if the general principle of seeing the problem in industry and carrying it back to the college for solution is emphasized and stuck to without being carried away by the mere manipulation, the Cincinnati plan does enable us to develop and select men of research ability in a novel but thoroughly satisfactory way.

Therefore, the question is raised as to whether this plan of shop-work, where the students spend part of their time in a real industrial plant, there meeting the real problems of industry and thence carrying them back to the school for discussion, does not offer a clew to a fruitful solution of the shop work problem.

The Massachusetts Institute of Technology has developed in the past year some similar work in the chemical and electrical engineering lines, and a very interesting experiment is now being developed in connection with the Western Electric Company by Professor Wickenden. I hope that Professor Wickenden is here today and that he will tell you what he is planning to do in connection with developing boys at the Western Electric Company and the Massachusetts Institute of Technology along this line.

Please notice I am not passing judgment on the answers to any of these questions. The report doesn't do that at all. It leaves you to decide whether you will try anything different from what you are now doing or whether you will continue in your present practice.

The third part of the report suggests solutions of the problems that have been discussed. It is hard for me to explain these suggested solutions because they are so extensive.

The first chapter deals with the problem of how to construct the curriculum. The report advocates the principle of trying first to determine what abilities an engineer must have in fundamental subjects; that is, what the engineer must be able to

do with mathematics, what he must be able to do with his physics, with his chemistry, etc. We must first determine what is the information and what are the abilities that every engineer must have—every engineer! I believe personally it is possible to determine this to a high degree of probability. Having determined this and having made a list of all the things that an engineer must know and must be able to do in mathematics, in chemistry, in physics, in shop-work and in laboratory work, I believe that it is possible to find out on the basis of experience he has already had and with a little experiment, how much time it is going to take to teach an average boy these things and to make him skilful in these things.

Therefore, I suggest that the curriculum consist in the first two years or the first three years (I will leave the time undetermined) of simply the things that every engineer must master. We will have to find out by experiment how long it is going to take to teach these things, for it may take a year and a half, or two, or three years; but there certainly is a common body of information and certain common abilities that are fundamental to all branches of the engineering profession and every boy should get them and get them first.

This information and these abilities cannot be developed, it seems to me, by mere instruction of the type that is now given. That is, if you merely instruct the boy in his mathematics as you now give it for five hours a week and don't make him feel that mathematics is an essential part of surveying and mechanical engineering and everything else the engineer does, his mathematical training is not likely to be so transferable and usable in engineering practice as it is if he feels while he is doing his mathematics that it is a real thing.

In order to accomplish this end there are three phases of engineering work which should be closely correlated and developed together. One is the industrial phase. The student must know something about the problems of engineering as they actually occur in industry and in the world's work. Mind you, I don't say it must be the Cincinnati type of expe-

rience; it may be work in industrial plants, it may be the Massachusetts Institute type or some other type, but there must be some school-supervised contact with real engineering work under real conditions. There must also be running parallel with this a certain amount of engineering laboratory work in the school where the young engineer learns to answer the questions that can't be answered in any other way. He finds the problems in industry and brings them back for solution to the school. Some of these problems can be answered by theoretical work only, but others can be answered only by experiments in the laboratory.

The third essential factor in the backbone of the course is the theoretical work in mathematics and science.

Those three elements seem to be essential to the entire course all the way through. We should not set the freshman in to studying only mathematics and theoretical chemistry with abstract scientific laboratory work, modern languages and English. We should not wait until the middle of the second year before giving any of the real engineering experience that seems so essential to close the safety valve and not allow so much energy to escape on the athletic field. In order to get more skill in the engineering work it is necessary that we have in the very beginning of the freshman year engineering laboratory work in parallel with the theoretical, mathematical, physical science work, in order to make the school real to the boy and give him a real enthusiasm for it.

But when you have done this, you still have not answered the question of how you are going to develop the man as a man and what you are going to do for the humanistic side of the engineer.

This question adds a fourth element which seems essential for every engineer through his entire course. This requires a definite course which is planned simply to develop in connection with the engineering work an appreciation of the human relation involved in engineering and the humanistic values he must understand if he is going to be a real man. There are a great many ways in which this can be done, but the type of

work which seems most worth trying is the type of work now being done at the Massachusetts Institute by Professor Aydelotte in his English literature designed to give the engineering student what he really wants to know about English literature. Professor Aydelotte begins by asking the boys why they came to college, why they want to be engineers, what an engineer really is, why an engineer is different from a mechanic, if there is any relation between the engineer and the writer of English literature, etc. He discusses those things and gets the students to write themes that are often remarkable. Incidentally the boy also learns to express himself clearly, to write good English and to like good English literature.

This same method can be applied to the study of sociology, the study of economics, and so on, and, therefore, the report suggests that we carry along throughout the entire course, occupying possibly a quarter of the man's time, a course of this sort which gives the student some acquaintance with and appreciation of the best things in English literature, philosophy, economics, and human relations generally. This suggestion completes the first part of the curriculum—the part that is common to all branches of engineering, and imparts the information and abilities that every engineer must have.

Throughout the entire course a great deal of attention must be paid to the testing and sorting of the men. Testing and sorting processes were in a very vague state a year or two ago. But an enormous amount of experience is being developed and collected at the present time by the efforts of the War Department to test and sort men for the Army mobilization. The Department now has psychological laboratories for testing all the men in two of the camps. They have personnel officers in all of the camps, and the work is making rapid progress. An enormous amount of information as to the meaning of these tests and their validity in sorting out ability is being gathered and digested and trade tests are being devised to pick out specific ability for certain lines. Before the war is over we will doubtless have some very re-

liable information as to valid methods of using objective tests and this will be of enormous importance in selecting students for admission to engineering schools and in sorting young men during the first year or two of their course, so as to decide whether a boy ought to go into the civil engineering or some subhead under civil engineering, or into mechanical or electrical engineering. In other words the experiences with the students in their common work that extends over two or three years should be utilized not only to train the man's ability to know and do things, but also as a means of vocational guide to select men and steer them, in the latter part of their course, into the special lines of work for which they are fitted. So the latter part of the course will be made up of large groups of specialties. Those who have been selected by the first two or three years' work as qualified for civil enigneering will be put in a group where for the next year or so they will deal first with all the materials of civil engineering not included in the first two years, but which are essential to all the sub-specialties of civil engineering. Then they will proceed from that into some particular specialty.

The next chapter deals with the teachers, and the essential point there is that the teacher is, of course, the crux of the situation; and that the present organization of universities is not well qualified to encourage teachers to experiment and undertake the sort of investigation that is going to be necessary in order to put a plan of this sort into operation. Hence an organization at the school should be made for the purpose of studying the teaching problem, and the school and faculty should recognize at the start that it is some business of the professor of physics what the professor of mathematics is doing; and it is some business of the professor of electrical engineering what the professor of chemistry is doing. We must drop the practice of simply deciding at the faculty meeting how much time these different subjects shall have and take up the practice of discussing what the work of each department shall be.

When this has become recognized practice, the mathematics

teacher, if he goes into it in the right spirit, instead of feeling that his interests have been sorely trampled upon when the professor of physics or engineering presumes to tell him what they want done, will find his work in mathematics has become enormously more inspiring to him and to the students. It will engender good feeling of the very best sort and result in a release of creative energy among the whole faculty. This is a cardinal point—that conditions be developed at the schools that will make the teachers want to study their problems together, instead of the present conditions which discourage the undertaking of anything that is not according to Hoyle. Those of us who had the temerity to break away and study education in spite of the present system took our lives in our hands. But yet we have lived till there is prospect we may still see that system develop.

I may say the position which I nominally hold of Professor of Education at Massachusetts Institute is created for the purpose of developing this kind of a study of the teaching problem at the Institute. The work has not yet started because of other more pressing needs, but there is a recognition and a willingness to do this work at the Massachusetts Institute, and it has got to be done in order to develop the teacher and to release his inventive ability and his creative energy, so that he can really put his enthusiasm into the problem on which he is working.

The last chapter deals with the professional engineer and its contents has already been presented at numerous meetings. In the opinion of the engineering profession itself, the most important things for the engineer are character and good judgment and efficiency to do things and to understand men. These are first, and then comes his technical knowledge and his technique. Hence the ultimate question is—how are you going to train people so as to develop these personal qualifications while you are giving them the requisite technique and skill and knowledge?

Of course, we all know the function of the school is to turn out men who know things and can do things; and if we can

give the other qualifications in addition, well and good; if not, the function of the school is still merely to make men who know and can do.

In this connection it would be well to read two of Hobson's books. One is called "Work and Wealth," and the other is called "Democracy after the War." They are published by The Macmillan Company. The second book has been out only a few months. These books suggest the fundamental conception which seems to lie back of this whole problem; namely, that the underlying question in any undertaking, and the basis upon which an individual makes up his mind as to whether he will do this or that or something else, is the question whether the thing is really worth doing from his point of view. He says to himself, "Is it worth while that I do this rather than that? Is the game worth the candle?" It is on that fundamental issue that the real decision is ultimately made.

The successful men are the men whose conceptions of what is worth while agrees most accurately with the underlying conception of the masses of humanity and who therefore make that judgment most accurately and most correctly. Hence in order to train the engineer to pass judgment on the question—is it worth while?—in a manner that shall be accurate, definite, and as it were inspired, we must train him to appreciate profoundly what humanity considers really worth while. This means, of course, that he has to be well versed in the humanistic side of life, so that the problem resolves itself into the question—"How shall we teach the engineer to understand and appreciate and fight for the things that humanity considers to be most worth while?" It is, you see, the same old problem of education that colleges and universities have been trying for years to solve.

The report suggests that much can be done to this great end by introducing into all of the engineering work and all of the humanistic work a consideration of the question of values and costs. Decision is always reached by weighing,—I am to get this value for this cost; is it worth while? So if

we include the appraisement of values and costs, we must not limit the discussion to monetary values and costs. Every engineer knows perfectly well that the decision as to whether to build a bridge or not is based ultimately on the answer to the question—"Is the value of the bridge to the community worth the cost?" A long series of more subtle appraisement of human values must precede the engineer's calculations. It is the power to solve these subtle problems which causes the man who is skillful to make progress and become the great engineer. A great engineer is the man who is subtly powerful in judging the balance of values and costs in the most far-sighted way.

Therefore in order to develop men who can appraise values and costs and make a sound decision, practice in this should be included in all the engineering work. This means that when the student is working at mechanical laboratory work he will be given as a problem to determine whether certain gears should be made out of steel or phosphor-bronze to fill certain conditions and in consideration of the price of the goods and the difficulties of manufacture, etc.

If questions like these are intelligently introduced into all of the engineering and the scientific work, it will do much to answer eventually the engineers' demand that we develop men of character, judgment and so on, along with technical knowledge and skill.

This is the gist of the report as it stands. I regret that it was not possible to issue it to the members of this Society prior to the meeting so you might have had time to look into the details and digest it and thus take part in a real red-hot discussion. I know the engineering schools are going to divide into two camps on this subject, those that are for it and those that are against it. You can't occupy middle ground. You either come all the way across or you stay all the way on the other side.

It is like the present situation in the world's crisis; you can't take the middle ground. As the darky put it in his sermon one morning—"Brethren, the whole world are at war.

Nations are scrappin' with one another, and this ain't no time for a nigger to sit on the fence. In the old days when I was a boy they used to make the fences out of rails, and a rail fence was a pretty good thing for a nigger to sit on, but now they make the fences out of barbed wire and this ain't no time for a nigger to sit on the fence."

DISCUSSION.

W. E. Wickenden: I think it is appropriate that I should first set you straight in regard to possible misconstruction which could be drawn from Dr. Mann's reference to my relations with the Western Electric Company. This is strictly a personal adventure and there is no formal alliance between the Massachusetts Institute and the Western Electric.

It is quite likely that in the search for the solution of some of these educational problems the engineering department of the Western Electric, which is located in New York and carries its own educational problem within its own organization in coöoperation with our colleges in Chicago, will seek cooperation with some institution engaged in engineering education which has the attitude and qualifications to carry that on, but nothing has yet been taken from either quarter which would indicate that that coöperation will be with the Massachusetts Institute.

At the present time, at least, as I stated before, the venture is entirely personal.

We face, at the present time, the universal problem of trying to make two engineers suffice where four were before.

The solution which Mr. Pfeif expressed yesterday as being the best experiment which the General Electric Company has succeeded in devising, that is, endeavoring to intensively train high school graduates to do the work hitherto given to graduates of college, is the immediate part of the program of the Western Electric Company.

The paper as presented is very much like a dinner presented in menu rather than in substance, and while we shall

be very eager for the opportunity to gain at length the impressions the paper suggests, it seems to me serious discussion of the contents of the paper must wait until it has had thorough perusal.

John F. Hayford: In connection with that last remark, it occurs to me this is rather an interesting case in which a committee report has been discussed very extensively before being printed; so if we discuss it here today, we are merely continuing discussion which has been in progress about four years.

G. C. Anthony: Mr. President, as the next conscripted man, I am very glad to say just a word concerning this report, and I don't mean to take but very little time.

First, I want to congratulate the Society upon inaugurating this movement, and I very much wish that Dr. Jackson, who really initiated the movement, were here today at the culmination of the work, if the presentation of the report can be called a culmination. It is only one step, however, in its progress.

I have been pretty closely connected with the work of the Committee since 1914 when it was really put on a firm basis to bring about the result which you have heard of today.

During this time Dr. Mann and I have had many discussions on the report, and I have agreed with him in nearly everything. Perhaps it has been a compromise, and it may have been a compromise of the sort the man and wife made concerning the color of the house, one of which wanted it red and the other white, and they compromised—on red. On one point, however, I cannot agree with him, and that is with reference to the two camps. Gentlemen, there is going to be but one camp. The other camp will not be possible. I think you may not go the whole distance, but you will go so far in the direction of the suggestions of the report that you will be within the limits of the one camp.

After a very careful reading, and, in fact, several careful readings, of the report, I feel most confident in making that statement. There are a good many points about the report

that I should like to have the Society discuss at this time, but I don't think it is proper to do so until we have the report in print.

There is one thing I want to suggest to those of you who are in my position, and that is the immediate consideration of our curricula. As regards the curriculum of my own institution, Tufts College, I feel that it has been knocked into a cocked hat by conditions due to the world war and that something must be done along more constructive lines than we have pursued during the last three or four years. It is only five years since we went through this whole performance and made an entirely new curriculum, but I shall go home from this meeting to take up that work again. I have one copy of the report and I shall insist upon that being read by every man who takes part in the discussion.

I know that all of you are pretty well informed upon the more important topics because they have been discussed before these meetings and in the *Bulletin,* but I think you ought to see the thing as a whole, for there is no part of the report that can be neglected.

I have been greatly interested and influenced by the historical section of the report and regret that the full text of the original could not have been printed. Nevertheless, if you will take into consideration these events of the past seventy years I believe that these facts alone will so influence you that you will find yourself forced to come over into the one camp.

Onward Bates: Mr. Chairman, if I had known that you were going to ask me to say something, I doubt if I would have had the courage to come here today. It puts me under the necessity of doing in public what I have often done in private, of apologizing for my neglect of duty as a member of the Committee. I suppose I had better explain how I happened to be on the Committee.

A long time ago, before the war, probably ten years ago, I received notice of appointment by the American Society of Civil Engineers as a member of its Committee on Engi-

neering Ethics. I thought that as a matter of course, I was all right on ethics and this was what might be called a soft snap. I promptly accepted, and when I learned the typist had made an error in writing the word ethics when it should have been education, I promptly refused to serve. My excuse that I was not competent was rejected on the ground that with so many professors interested it was well to have one ignorant man on the committee. Now, this was a committee of the American Society of Civil Engineers with its members located in Boston, New Orleans, Madison and Chicago. We could not get together for meetings, and had nothing to start on, and as a committee were not able to make much progress. Our Chairman, Mr. Desmond FitzGerald, of Boston, was very much interested and did all he could to promote this work under such conditions. Even after we were merged into the general committee we could not make much progress until we obtained the assistance of the Carnegie Foundation, and particularly the guidance of Dr. Mann. I wish to say personally, that I thank Dr. Mann very heartily and admire him for what he has accomplished. When I was asked to sign the preface to this report I replied that I thought it a privilege and an honor to have my name attached to it.

What difference does it make if we do divide into camps on this report? It will simply be evidence of the value of the report. I agree with the last speaker that when the report has been studied the result will be that we will get together into one camp, and I am sure we will all value the report after it has been studied and discussed, more than we do now.

There is one part of the report in which I am deeply interested, that is, the professional demand for engineers. What does a university exist for except to make men, and the question is, What kind of a man do we want to make? The kind is well set forth in the report. I think if this were the only chapter in the report, its contents would justify all the labor that has been expended.

H. C. Phillips: Dr. Mann has said that he thinks there will be two camps involved in this report. I don't think he perhaps appreciates the size of the present-day camp. We are going tomorrow afternoon to look at the Great Lakes Training Station, which is practically typical of a good many of our present encampments. It is so large that it has strayed over the railroad tracks, and the only reason it hasn't gone out in the lake is because it found an outlet to the west. I think we are all going to find ourselves in Dr. Mann's camp.

I want to acknowledge a debt of personal gratitude to Dr. Mann.

Five years ago the alumni of Princeton were good enough to consider me a fair representative to put on the board of trustees for the purpose of helping out in the reorganization of our engineering course at Princeton. We went at it pretty hard. We have from time to time had matters come up to us for decision. There was an active body of engineering alumni working in New York, a committee of which took very much this ground: "Here is a man working at this thing who knows more than any of us hope to know. We will pump him at every opportunity we can." We have found Dr. Mann a well of information. In the five years just passed, we have made considerable progress at Princeton. At the end of that time, we find ourselves with a temporary three years' engineering course in civil engineering with other collateral courses also pressed into an intensive schedule, with probably eighty-eight per cent. of our four years' course available in a three years' course with summer sessions. We are working with some of that steam which we have gotten into those of our students that we have left.

We have Dr. Mann to thank for many suggestions due to his great knowledge attained of the subject of engineering education, and which he has shared with us freely during the progress of the work and not attempted to hold up for the final report.

F. W. Sperr: In our small way we have had this three-year practice of an attempted intensive curriculum, in what

we think quite successful operation for something over twenty years, and I assure you it works well with us.

Ira O. Baker: Mr. Chairman, before the discussion is closed I want to express my appreciation of Dr. Mann's report. I doubt not that it is epoch-making; I doubt not that it is putting us all upon a new track, and that we will have new efficiency and greatly improved results.

I delayed making my remarks so as not to divert attention to a minor matter of his report. I should like to ask if he may not have made an error in one phase of his report. As I understood him, he said that a certain class of shop-work was first developed at Massachusetts Institute of Technology. I think he said it started in 1876. Perhaps I didn't understand him rightly; he may have said 1877. One of the advantages of a gray head is that he remembers some time back. I think that credit for priority in what has since been called the Russian system of shop-work belongs to the University of Illinois. I was not connected with either the Department of Mechanical Engineering or that of Architecture, but in the Christmas vacation of 1876 I was appointed to escort President Runkle about the shops of the University of Illinois, perhaps because other people had money enough to go off on a vacation and I didn't, and I know that he was very much interested in looking over the university's shop-work. It was in the next fall, I think, after that that shop-work was introduced at the Institute of Technology. I do know that at the Centennial Exposition at Philadelphia in 1876 the University of Illinois made a considerable exhibit of shop-work in mechanical engineering and a somewhat lesser exhibit in architecture.

The first shop-work at the University of Illinois was introduced by Professor S. W. Robinson, professor of mechanical engineering, and it had some very high qualities about it which I shall not now attempt to speak of. I may say, however, that it was a cross between what Professor Mann described as the Worcester plan and the Russian shop method. It was because Dr. Runkle saw that exhibit at Philadelphia

that he came to the University of Illinois, and when he arrived at the University of Illinois the methods employed had been somewhat modified to become more in accordance with the Russian shop system.

John F. Hayford: When I listen to Dr. Mann's answer, I will be thinking to myself that the most difficult problems and questions a man has to decide are just those as to how to distribute the credit properly for good things and settle the question of priority. The difficulty is much greater than the importance.

Dr. Mann: Mr. Baker is perfectly correct in his statement of the case. The University of Illinois started shop-work at the very beginning when it was founded. It was founded in '67 and they began it at once.

Professor Baker: No, not until January, 1870.

Dr. Mann: I know in the catalog I studied there is a description of how the men built the equipment to run the shops with and a number of things of that sort. Therefore, in thinking on the subject and attempting to get categories in dealing with this problem, I had classified the University of Illinois more on the Worcester plan than on the Runkle plan, because it did encourage production of useful things in connection with shop-work. Now the Runkle plan was simply a clean divorce between the production and the instruction, and they developed this intensive following of just the fundamental machine operations and did not attempt to construct anything. That was the point I wanted to bring out.

Professor Baker: The University of Illinois made that cleavage in 1876 after the Centennial Exposition.

H. S. Jacoby: Mr. Chairman, I wish to express my high appreciation of the splendid work done by Dr. Mann, and I am sure that every one of us looks forward eagerly and with intense interest to reading the detailed report.

In view of the reference which Dr. Mann has made to the matter of objective tests of students to see results of the work done, I was wondering whether it would not be of interest if Dr. Mann should give us quite briefly, if the time is avail-

able, just an outline of what has been the recent trend in public education in that direction so far as objective tests are concerned. I think it ought to be very valuable for all of us to know the facts. That matter has received attention and doubtless will receive a good deal more attention in public school education.

Dr. Mann: Professor Jacoby has got me out of my field now. I am not sufficiently posted on what is actually being done in public education except to know that Detroit some years ago employed specialists and has developed a system of objective tests in arithmetic and mathematical work in the schools. The Curtis tests have become standard and Mr. Curtis is employed regularly in Detroit as an investigator of the methods of testing.

I know that Boston and Cleveland and one or two other towns have what they call a Director of Educational Research, a man there on the grounds just studying the way of testing and measuring the school output in objective methods. Those general facts are all I know about it. I have no detailed information. I merely know the thing is under way in the schools and that they are developing that field.

H. S. Evans: I am not sure whether this is the proper time to ask certain questions, not having heard the report in detail, but in regard to the matter of standardization I was wondering if Dr. Mann had in mind something for an engineer in the way of bar examinations for the lawyer, whether we are coming to that standard of engineering education. In the second place, from the standpoint of a state university man, I would like to know whether he has considered the problem that we have to meet in certain cases establishing special engineering departments in the ordinary college branches, that is, a department of engineering mathematics, a department of engineering English, etc., and you might even carry it on down to physics and chemistry. In a certain way we already have a department of engineering mathematics and English, and we have had certain difficulties, as I presume every man connected with state institutions has, in some of these other

lines, such as chemistry, physics, and the like. Does that mean that in the state universities we are going to be handicapped permanently in teaching engineering, or does it mean that we are going, in a way perhaps, to have to segregate engineering from the rest of the teachings?

Dr. Mann: To the first of your questions, that of standardization, I have no answer. That is a matter we are going to work out by experiment. Personally, the word standardization, in view of what it has been used for in a number of cases in the past few years, sends a sort of shudder down my back. I believe that the types of standardization that have been employed are killing the enthusiasm and vigor of a great deal of instruction. I am just finding now in Washington an effort to get out what they call Standard Army Manuals to show exactly how an automobile man should be trained for a specific function. Dr. Bishop says they won't use them if they get them out. I hope they won't, because that type of standardization just reduces things to a mechanical routine and is, of course, deadly.

I am not at all sure but that through the objective tests we are going to be able to construct ladders of achievement to see how far a man can climb up a scale of grading that will enable us to measure the capacity of the man. That, in a way, is standardization, but it isn't mechanical. I don't answer that categorically, but suggest that it is a matter of experiment.

In regard to the other question I believe, and this is simply my personal conviction, that as soon as you get development in your school, in your engineering school, the type of mathematics that is a real man's job for an able-bodied student that puts him right up on his toes so that he had rather go to the mathematics class than to the foot ball game, the question won't come up as to whether you are going to have separate classes of engineers for art colleges, because the art colleges will take the kind of stuff you are giving engineers and be only too glad to get it. Again, it is the question of

experiment and organization. If the thing is set up right, I don't believe the question will ever come up.

T. U. Taylor: The gentleman from Colorado has touched upon a real vital issue in the standpoint of state universities. We have applied mathematics, as we call it, but we have had trouble with physics, chemistry and English. One of the College of Arts professors ought to be willing to teach the engineers. Even after you get your mathematics, engineering mathematics, applied mathematics, and the like, set apart as distinct with a corps of teachers, then you have a problem inside of that as to what mathematics they should take. We had men come over from the college of arts who had taken trigonometry and go deliberately into our trigonometry classes because they said they found out the college of arts trigonometry was inadequate. We have had them repeat the course of their own volition.

Then there is the question of getting the engineer interested in English. We prescribe two full years of English in addition to a full course in economics, and our students are often thrown in sections with the college of arts students.

A few years ago I asked several questions on the blackboard at a meeting of freshmen. One was, "How do you regard English?" One of the best students we had, the most enthusiastic engineering student, who has made as great success as any one, boiled it down to this statement, "It torments me."

I told the English faculty about it without giving the student's name, and yet in twenty-five years we have gotten no solution whatsoever, and if we can get a solution to this one question of English, I believe we can get it in others, in physics. We have it in chemistry for the simple reason that the head professor in chemistry is a graduate of our engineering college. He went over to chemistry largely by accident.

This question in state universities is a vital one, where the college of arts insists upon largely dictating the action in engineering problems.

Director Hayford: We are in the position in this Society

to look at engineering matters from the point of view of the department as too narrow a view. We know you must look at those matters, to get a good perspective, from the college of engineering point of view. We ought to go a little further and take the university point of view, and as soon as we do that I think we will find Dr. Mann's suggestion is the real thing, that if we do the right thing in the colleges of engineering they will do the same thing in the other places, because after all the whole university problem is a problem of training men for service. That is true in every college or university, even in that part known as the college of liberal arts, where the particular kind of service isn't thoroughly defined in the minds of the student while in college. Still, their problems are the same as ours, and, after all, we should solve them together.

Dean Taylor: I can say if we get Professor Mann's solution in regard to English, that solves our problem. That is what we want, but we haven't got it.

A. H. Fuller: I think we have quite a bit of information right now on the line of correlation of departments. I have an idea when Dr. Mann's report as available, we will find quite a bit there. Perhaps there is still more which can be made available. I have had the opportunity of going through two course revisions during the last two years. One was in a rapidly growing western state university and the other in a conservative eastern college. In both of those, certain fundamental principles prevailed.

At the University of Washington two years ago the first work in starting a course revision was to ask every instructor in the university who was giving work for the engineering students to give an outline of his work to the curriculum committee. The committee went over each outline fully and asked the man who prepared it to come in and discuss it. In the discussion an attempt was made to get him to see the viewpoint of the engineering instructors and the demand of the engineers, and the solution was worked out with him.

In a recent revision at Lafayette College, commented upon

in the February BULLETIN, every effort was made to secure the correlation of departments by coöperation in committee work and numerous conferences.

The underlying principles of the resulting curricula at both places have been well stated in a recent Lafayette bulletin as follows:

1. To arouse and maintain the interest of the student by bringing him into contact with practical engineering problems as early as possible in his college career.

2. To place the broadening cultural subjects, such as modern languages, economics, business law, and psychology, at a later period when the student is in a better mental attitude to properly appreciate their true value.

3. To lay even greater emphasis on English, economics and business law in order to more thoroughly train the student for executive and administrative positions in the technical-business world.

4. To maintain the freshman year alike for all courses so that a choice of the particular branch to be followed need not be made until the sophomore year.

5. To emphasize broad fundamentals and to offer the more specialized technical subjects as electives, and

6. To provide to the fullest practical extent for study and computation periods for the development of theory and the solution of problems.

These courses are not the last word by any means but are distinct improvements over previous ones, and seem to be directed toward the camp referred to in Dr. Mann's report.

It seems that as more study is given to the revision of curricula the more men will be found in the Mann camp and that more progress will be made toward the correlation of departments.

Dean Evans: I don't want to be misunderstood. I didn't want to leave the impression that we had any serious condition at the University of Colorado. As a matter of fact, things are going on rather well, but we have started into this

segregation of these two departments, the department of engineering mathematics and the department of engineering.

My question was leading more to the matter of the future, as to which was going to be the policy.

E. R. Hedrick: I speak as one of these professors in mathematics who are often reviled and discussed almost universally on such occasions. Thus I think mathematics may be used in illustration more than any other subject, and justly. It is one of the central topics around which such a discussion hinges.

I want to say that I, for one, agree very thoroughly with the proposals that Dr. Mann has in mind as far as I understand it, and I am very anxious personally to coöperate with any such joint committee. I believe you will find that is the case on the part of a large number of mathematical men, provided, I think, they are approached in the proper spirit. I think enough of you know me to know that that is true in my own case.

I come to these meetings. After all, only a handful of professors of mathematics in the country do that. But it is your fault. Some of the remarks I have heard here today are not remarks calculated to win over the mathematical men to your point of view. They are remarks of hostility. If you wish to make plain, with the mathematical faculty, the very excellent points you have in mind and with which, let me say once and for all, I am in absolute agreement, then in order to do that, the way to approach them is not in an attitude of original hostility. I believe that if you approach them in a reasonable way, you will find an astounding agreement with you. It is only a question of human nature. If you approach a man by calling him certain epithets, you will get immediate response. This is not because I am against the things that are here proposed, but because I am in thorough agreement, and I think the things you are proposing are not alone of benefit to the engineering part, but are the salvation of the mathematics as a whole, in our academic department as well

as in our engineering department. That is the reason I don't believe in separation of the department.

I enter a plea then not for or against this program, but a plea for your approach to the men in the mathematics department in a spirit of reasonable persuasion rather than hostility.

I want to even suggest to Professor Mann that he include among these mutual relations not only that the professor of mathematics shall listen to what the professor of physics has to say, but that the professor of physics shall listen to what the professor of mathematics has to say. Once in a while give the professor of mathematics a chance, not that he knows anything, but to make him feel good.

The psychological effect is quite clear. If you want to get his interest in your whole department of engineering, and that is what you want after all, be considerate of him. You want this a joint affair, you want these men working with you. We want to be of service, we are willing to be servile even, but don't let us be made slaves.

W. J. Risley: I was hoping, Mr. President, that Mr. Hedrick would say something along that line because I know what Mr. Hedrick represents in the Mathematical Association of America.

I think I am fortunate in some ways. I went to a college to study electrical engineering; I was unfortunate in having gone to a small college, that is, I was raised with the point of view of the fellow who had to get something to use it. I switched off to mathematics. I think about five per cent. of the membership of this organization are professors of mathematics, but a few of whom attend these meetings. I think since they are useful to a much larger extent than that, that it is a crying shame that not more mathematical teachers tramp around to them. Hedrick and I always have a little mathematical get-together when we go to these meetings.

I want to express my appreciation of what Dr. Mann has done since he came back from Germany. I met him in Joliet and have been in contact with him almost constantly since he arrived.

I couldn't conceive of a better thing than to suggest to our general faculty meeting, at which a résumé of this report will come out after it has been read by several heads of departments, that it be discussed for the good of the general faculty. I think if you carry back Dean Anthony's idea that every man shall study this in detail and then get together and talk about it, that the work will be influenced by it.

I appreciate Mr. Hedrick's last remark that the professor of mathematics shall sometimes be allowed to lead the way. More than once I have fought the other professors in insisting that I must teach certain things and in leading them to see that they might better be teaching some of those things, too.

In handling freshman mathematics, I went to some of the professors and asked them what it was the junior or sophomore students should know, who came from the department of mathematics, that they didn't know. One of these men said, "I have two or three cubby-holes of that sort of stuff put away, but I never found any one to ask for it."

By coöperation with those professors I have learned a good many more points which I have often emphasized in teaching mathematics. I think when this thing is carried through the encouragement will come. It will be a coöperative encouragement to the professors of mathematics and physics. We certainly, as an American Association of Mathematics Teachers, are with you in spirit if we can get these spirits in tune so that we will know our problems.

Dean Bishop: Mr. Chairman, I would like to offer this suggestion to our Committee on Mathematics, that they recommend to this Society and the Association of Mathematics Teachers of America, a joint committee on the teaching of mathematics, in that way securing close coöperation of the engineers and all of the mathematics teachers.

Dr. Mann: There are several questions raised that I just want to set your minds at rest on before we adjourn. Mr. Risley is evidently looking for an answer about that Joliet business. It is perfectly obvious to everybody now why after

three years living in Germany I was a fit candidate to go to Joliet. But I would like to know what Risley was doing there.

Mr. Risley: I was inaugurating the first course in junior college mathematics at Joliet.

Dr. Mann: In regard to Dr. Hedrick's question, he has known me long enough to know that my point of view is the same as his. This is an essentially coöperative program that the professors of mathematics, English, history, and even the foreign languages, are going to coöperate with the engineers in carrying out, and the engineers are going to coöperate with them.

The result, as I see it, of such coöperation, taking up a problem of coöperative solution, is going to make engineering education the liberal education in the future. The engineer is said to be the man of the hour, and he is.

Therefore, I want to just close the discussion with a quotation from Carlyle:

"Down by the river stands the old stone mill, grim, time-defying. It was Enoch's hand that wrought it and made the rude rocks to send the water. He was so good, so true, dear old Enoch. No Ilian has he destroyed, but much has he built up. Not arms and the man—tools and the man; that were now our epoch were the generous arrived who could sing it; for what are tools from the pen we now write with to the hammer and plummet of Enoch Wray but weapons with which to do battle against unreason, henceforth the only legitimate battle."

Discussion of the Student Army Training Corps.

Dr. C. R. Mann: I should think this audience would be almost tired of hearing me talk today.

I am very much interested in the suggestion that the gentleman made a few minutes ago of the necessity of doing something to keep up the supply of engineers, because a number of us have felt that that was a pressing necessity and some-

thing must be done to assure the country that not only engineers, but also doctors, chemists, physicists, mineralogists and all other forms of technically trained and skilled help will be kept supplied as an early essential.

It is an enormously difficult task to get the Army to make any changes in its system, but in spite of that the plan which I spoke of this afternoon has been finally approved. I was asked to review it briefly for the benefit of those not here this afternoon.

The fundamental conception of the plan is that the engineering or technical schools, including the medical and scientific schools of the country, should be regarded as a very large asset to the country if they can be coördinated into one large training plant. Therefore, the first notion of this plan that I described this afternoon was that some arrangement should be made whereby those schools should be kept full of students and should be kept supplied with the necessary teachers and thereby kept in operation.

In order to meet the first requirements of keeping the full supply of students, the Secretary of War announced on May 8 that what we have named "Student Army Training Corps" would be established next fall at all colleges that could muster one hundred able-bodied students for the training. These students we conceived first to be between the ages of eighteen and twenty-one so that they can volunteer and enlist in the Regular Army in the service of the United States and become then soldiers of the United States. They will be kept on active duty after enlistment long enough to get their uniforms and equipment which the government has promised, and then they will be furloughed, placed on an inactive basis and sent to various schools, that is, the schools of their own selection. They will remain on furlough status, studying those things they choose to study, until they reach the draft age. They have to register at twenty-one the same as any other boys, and when their draft calls are reached the question comes up as to whether any particular boy shall be called into active service or shall be continued at the school to fin-

ish the line of work in which he is engaged, and at that time the school authorities and the military authorities at the school, for there are to be Army officers stationed at each school to give these men military training along with their technical training, will decide which of the boys are ready for active service and which shall be continued to finish their courses.

That decision will be based upon two things. One is the military situation, that is, it is proposed to adjust the number of students in various technical lines each year to the number of trained men that are needed for the entire war machine. That does not mean simply the Army, but includes, as I stated this afternoon, also the Navy and the industries—essential industries, so that a summary or a survey will be made each year of the needs of the country or of the war machine for trained men, and care will be taken that enough men are left in college to finish their work to supply that need each year.

It may happen that enough students will not volunteer and there will not be a plentiful enough supply to meet all the needs. I am expressing my own opinion as to what will happen then, but I believe that under those conditions men will be returned from active service either in camps or in the Army—men who have been to school will be returned so as to see to it that the supply is kept up to what is actually needed. Now that takes care of the boys, or we hope it will take care of the boys under twenty-one who are in a position to volunteer for enlistment.

The boys who are already of draft age who should be taken care of or permitted to continue their studies are taken care of by that amendment to the selective service regulations which I read to you this afternoon. That provides that any student in a recognized technical school who is taking full term courses in engineering, or medicine, or physics, or chemistry, or any other technical branch which is essential to the prosecution of the war, may enlist in the Enlisted Reserve Corps, so that if a student is over twenty-one and, therefore,

cannot volunteer because he is subject to draft, he may enlist in the Enlisted Reserve Corps of the stated school if the authorities believe he is a suitable candidate for further development.

This amendment to the selective service regulations also takes care of the teachers, because it provides that any registrant who is an essential teacher in any of this war work may be enlisted in the Enlisted Reserve Corps and placed on the inactive list and sent to college, so that the plan so far has been approved, permitting the enlistment of all students in technical schools of all kinds and the enlistment of essential teachers of draft age. I might say the enlistment of essential teachers over draft age and the furloughing of them to their stations is permitted, and the enlistment of teachers over draft age in the Enlisted Reserve Corps is permitted by the regular regulations without any amendment, so that it is possible under the regulations as they stand today to have all of the teachers and all of the students in the schools enlisted.

It may cause some shock to think that we were going to enlist or call for voluntary enlistment of boys from eighteen to twenty-one. The point and purpose of that is not to get those boys into active service; it is the direct reverse of that. The point is to remove from the boys the uneasiness, the restlessness, which they now feel. The boys just graduating from high school, the freshmen at school and college, are now concerned about their part in the war and they are eager to get into active service; they are wondering whether they had better enlist in the Navy or the Army or some other branch of the service. This is to enlist the boy and take away that restless feeling, put him in uniform and tell him that the War Department recognizes his going to school at this time as an essential part of the war program and an essential activity. He will be furloughed to school and not permitted to leave until the authorities say that so-and-so had better be called into active service. So the purpose of the enlistment is not

to get men into active service quickly, but to keep them out of it until they are really developed for it.

Those are the main points in the scheme, and I would here repeat that that has been entirely approved by the War Department. Mr. Baker has promised the schools that it would be carried out. It has been approved by the War College and the general staff.

There is just one question that remains to be settled before the public announcement is made, and that is the question of who is to administer it, what kind of an organization shall administer it at Washington. That question is under consideration and may be decided at any minute. As soon as that is decided, there will be a large amount of publicity given to the fact in order to make the boys who are graduating this year from high school aware of the fact that they have this opportunity of enlisting and remaining at college and that the War Department regards that as military service for those boys.

Those are the essential points of the plan as outlined this afternoon, and I shall be very glad, if I have not made it clear, to answer your questions.

Dean Richards: There are three questions which occurred to me while Dr. Mann was talking. As I understand it, any boy between the ages of eighteen and twenty-one may voluntarily enlist in the Army Corps to be ordered into active service in the event he fails to make a record which is satisfactory during the time he is a student, or unless he maintains a reasonably satisfactory record in the school. That is correct, is it not?

Dr. Mann: Two things may happen to him if he fails to keep up with the college work. I imagine that he may select what he desires. He may be discharged and may take his position under the draft, or he may be called into active service.

Dean Richards: As I understand it, this is a purely voluntary enlistment of boys between the ages of eighteen and twenty-one. I should like to inquire whether the committee

has considered, or has any information which will indicate whether this voluntary enlistment will actually work out, that is, whether the boys will be sufficiently interested to enlist and thereby go to college unless there be some inducement other than the mere fact that they will be possibly permitted to continue until graduation. Of course, you have offered the inducement of putting them into uniform. Do you propose to pay anything to these boys during that period? Will they be furnished their uniforms? Will they get any sort of remuneration?

Dr. Mann: The uniforms have been promised from the War Department. They will be furnished such equipment as they would be given at some camp. They will be given arms and a good deal of marksmanship. If a lot of them graduate and show by achievement that they are worthy candidates they will be allowed to graduate and will be eligible for Officers' Training Camp work.

There is no pay provision at present. I am not at all sure that one won't come.

Dean Richards: As I view the problem, there are many things that would interfere with the boy coming to college at the present time. First, the increased cost of living and the increased demands upon the purse of his parents or guardians will interfere. Secondly, there is the fact that the industries are so terrifically short of men that they are offering rather high rates of pay to young men who are not well trained. That may result in a good many boys going into industrial work until they are registered, which they had at least rather do than go to college.

It seems to me, therefore, that it would be exceedingly desirable if, in addition to giving this general recognition, they might be considered as sufficiently in active service to receive some kind of financial recognition which would in part compensate for the greatly changed conditions of life during the past few years.

The third question which your last statement brings up is the determination of the conditions under which a boy may

be continued after he has been registered. Have you worked out any plan, or is there still something to be done in the future? I should like to know whether it is to be as absurd as the plan provided for the Engineering Reserve Corps.

Dr. Mann: Let me take the question of pay first. The students that are now in training are regular enlisted soldiers with full privates' pay. They are sent to school for two months. We have received several requests to keep certain of those students at school for three or four months because some of them have shown particular abilities.

The minute you do that you accept a general proposition that if a man is in uniform in training, the government puts him on a paying subsistence. This is just on the eve of being expanded to a six month period. I don't see where we can logically get through on this proposition unless the government assumes the paying basis. I feel that that is the only democratic thing to do, it is the only democratic solution to the problem. Unless that is done, a large amount of high grade talent is being cut off from government service that ought to be available. That is my own personal answer to that particular proposition. We have no action on it as yet.

As to the conditions under which a boy may remain, this Enlisted Reserve proposition which has just gone through says that under such conditions as the Secretary of War may prescribe he may continue. Those conditions and regulations have not been framed yet.

There is a meeting called for next Monday afternoon. We have asked each of the staff corps to appoint a delegate or an officer to represent them in this Enlisted Reserve matter. This meeting is called for Monday Afternoon with the Advisory Board to draw up those regulations under which that Enlisted Reserve question will be administered. The same thing will be true of the conditions under which the furloughed men will be continued. That won't come up until next year some time, and we purposely are making no specification of that as yet. I say purposely—that is my view of the case; until we get a chance to get into active negotiation

with the colleges, there will be no definite action taken, because the only way in which we are going to make this thing go with real spirit is not to have the War Department set up a lot of regulations to start with, but to have the War Department set up certain government principles on which we propose to operate and leave the detailed regulations to be worked out in coöperation with the colleges after it is in operation. That is what we are going to do with our technician proposition.

The machinery is gradually getting oiled down on a real working basis. That is my attitude toward the policy in regard to such questions.

Dean Richards: There is one further question. Does this new plan contemplate turning over the technical students of the country to the Army?

Dr. Mann: My idea is the administration will still be vested in the university or college authorities with the Army training merely the military part of it, as the case now is in the R. O. T. C. plan.

C. S. Howe: I would like to ask when this change in Section 151 goes into effect.

Dr. Mann: It went into effect June 20.

President Howe: Yet the regulations in regard to it have not been sent out. How will that effect the fellows who registered on June 5 and who have, therefore, been recommended in the last few days for the Enlisted Engineers' Reserve Corps?

Dr. Mann: I imagine they will go through until this thing is put into effect. They will have to administer it on the old basis until the regulations are published.

President Howe: It seems to me it would affect quite a number of college students. I know we have recommended a number after June 5 for the Signal Reserve Corps and the Engineers' Reserve Corps. The papers have come back and they have been allowed to enlist in the Army. As they have not yet received their serial numbers and questionnaires,

their papers could not be filed with their questionnaires and they could not be filed with the Local Board.

Dr. Mann: I guess the old plan will continue in operation until the new regulations come out.

President Howe: I understand the Signal Reserve Corps is to be abolished.

Dr. Mann: You are to bear clearly in mind this: There are five branches of the Enlisted Reserve Corps. They are the Medical, Ordnance, Quartermaster, Signal and Engineer Corps. Those are the five essentials of the Enlisted Reserve Corps. Any man who enlists in the Enlisted Reserve Corps enlists in one of those divisions. He is not enlisted in the infantry or the cavalry, but he must enlist in one of those five I have mentioned.

All those corps exist whether there are any students coming in or not. The new regulation specifies that permission to enlist in one of those divisions is up to the Committee on Special Training.

It doesn't abolish them; it simply takes control of the situation from the separate staff or heads and puts it into the committee's hands, so the schools have but one office with which to deal.

President Howe: I might say further that the Local Boards in Cleveland say they have been ordered to no longer take men in the Enlisted Reserve Corps and that order reached them since June 5.

Dr. Mann: A rumor went around the other day that there would be no more individual inductions. They haven't understood the order.

President Howe: I have found that out in the past.

Dr. Mann: There was a notice out on May 13 that students might be inducted and furloughed for the purpose of working in industry.

President Howe: It is also true that the Local Boards are making trouble for the students who are trying to get into the Reserve Corps. That problem confronts us because we don't know what to do with those men. They have complied

with every rule of the department, yet the Local Boards will not place their enlistment papers with their questionnaires.

Dr. Mann: I don't know what to answer to that; if you will send the papers down to us we will straighten it out for you.

Dean Bishop: This trouble arises from the fact that recruiting officers refused to accept the papers.

Dr. Mann: Now, I may say that this regulation that has just been passed went all down the line. It started with the Provost Marshal General and went from him to the heads of the different divisions and was approved by them one after the other. Then it went to the Judge Advocate General for a ruling as to whether it was legal; the Judge Advocate General ruled that it was. It has been all down the line, and if anything has validity in Washington, I am quite sure that has. If the local boards don't understand it properly we can get that straightened out.

There is a new order in reference to local individual induction which goes into effect on July 1, which transfers all power for local induction from the local boards to the Provost Marshal General's office. Hereafter the local board and recruiting office have no power of individual induction. All those cases are to go to Washington to the Provost Marshal General after July 1.

The report is spread out that individual inductions are cut off altogether, but it isn't so. They must all go through the Provost Marshal General's office.

G. C. Anthony: I would like to ask what the status of the student is who is already a member of the Naval Reserve. Men are willing to go into this new reserve, as they understand it, provided it will lead directly to the Navy at the termination of their college course.

Dr. Mann: As to the Navy proposition, it seems to me that if a boy is clear in his mind that he wants to go into the Navy he should enroll at once into the Naval Militia and be furloughed to the schools, as all of the Naval Militia students are being handled now. There are a number of college stu-

dents who are enrolled in the Naval Reserve and furloughed by the Navy to college to complete their courses. If the Navy is willing that boys of that sort should drill with the boys who are enlisted in the Army and if we can work out a coöperative plan with the Navy whereby the entire group gets military training together, that is, ordinary drill in marksmanship and things of that sort, then the school can handle them as one military unit, but the details of that lead to a lot of ramifications and we haven't worked it out.

Dean Anthony: I understand the man may now enter the Naval Reserve and be furloughed back to the college, but we do not know whether he will come in with the class that will receive military drill until he may have some understanding with the Navy.

Dr. Mann: It is the policy of the committee to do so, but whether we can get that O. K.'d by the authorities remains to be seen. I understand the present rule is that no man under the commission grade in the Army can get a discharge from the Army for the purpose of joining the Navy unless he is going to be commissioned in the Navy, and vice versa—no man under the commission grade in the Navy can get a discharge from the Navy for the purpose of joining the Army unless he is going to be commissioned in the Army. We want the government to get the maximum service out of every boy. We want this thing decentralized so the school regards it as its problem to take that group of boys and develop them for maximum service.

President Howe: Under this new plan the students enlisted in the Army will receive military drill. How about the boys who do not wish to enlist; may we require them to take military drill?

Dean Taylor: The school can do that.

Dr. Mann: Yes, the colleges have to do that. All boys have to receive that drill.

W. J. Risley: You couldn't enforce the drill though, Dr. Mann. You couldn't drill under regulations unless you furnish the government regulation officer.

Dr. Mann: In this particular case the War Department promised that they would get officers.

Professor Risley: Yes, but when the time comes they may not be able to supply the officers they pledged.

Dean Taylor: This list that you read of chemistry, physics, etc., does not absolutely preclude other avocations that this committee will pass on, but anything else not specified in the list will have to be passed on specially by the committee. Is that right?

Dr. Mann: All cases go to the committee and they are there sorted. If it is an engineering proposition it will be submitted to the chief engineer, etc.

Dean Taylor: Then it is limited to those particular subjects?

Dr. Mann: Oh, no!

Dean Taylor: You mentioned a very critical situation and a vital thing, one which will be a great factor, that is, that a lot of very valuable material never gets to college and never will get to college unless it is recognized by a slight amount of pay, and I believe that small amount of pay by the government will give it a status that nothing else will. I think it would nearly double the efficiency.

Dr. Mann: If a boy does not enlist he is not entitled to wear the Army uniform and take part in Army instructions given by the Army officer, but there is no objection to the school giving any drill of its own if it wants to. This is in answer to President Howe's last question.

I believe if this thing is set up under the conditions as we can see them, and we are trying to get it set up, that it will be more popular with the boys at the school than the foot ball team and that we will have no trouble with them not wanting to enlist.

President Howe: I think you are wrong, Dr. Mann. We shall have a very complicated and a very trying situation. If the college authorities cannot compel the students to take military training, or if the college authorities have to hire an instructor to drill those who do not enlist, there will be difficulty. My feeling is that the large majority of boys from

eighteen to twenty-one will not enlist under the conditions. If they were to be paid, I think they would, but I doubt if they would simply go in for the privilege of going into the Army and continuing in college. At least, we shall have a great many who will not. They prefer to wait until they are twenty-one and then see if they can't get into one of the Reserve Corps. Those Reserve Corps are very popular, and the fellows feel that there is no use for them to enlist in the Army, where, if they wait until they are twenty-one, they can enlist in the Reserve Corps. Why should they enlist as privates when they can do that?

Dr. Mann: That is a question we are very glad to have the schools discuss. Personally, I think that as far as leading to an Engineers' Training Camp, ours will lead even more directly than the ordinary training, because while they are enlisted as freshmen, sophomores, etc., as soon as the school is able to sort out the prospective engineer, his work will all be in the engineering line and he will be headed for the Engineers' Corps. We may not be able to establish an Engineers' Unit in every school. In small schools there will be only an infantry unit. In an institution like Cornell there will be several units—medical, engineering, infantry, etc.

It is a very difficult problem and it is one bridge that we haven't crossed. We haven't made any ruling, and I hope we won't make one until we get a chance to see what actually happens.

Dean Richards: You just raised a question which I didn't get on the original discussion. You speak of organizing an infantry unit. My understanding was that these men would be enlisted for technical training primarily. Is it really the plan to take them into any branch of college training for the period of eighteen to twenty-one?

Dr. Mann: Yes. In the beginning the freshmen and sophomore classes, while they are to be sorted, will be largely infantry units. In a school like yours, however, you have a large enough technical school to establish an engineering unit.

Dean Evans: There is a question I wanted to ask somewhat

along the same line. At the University of Colorado we have an R. O. T. C. Unit which is the same as many of the other schools have, and the regents passed a ruling that was to be compulsory beginning this Fall. It was optional last year. Under that ruling all of the students were compelled to take military drill. We have our officer and everything is arranged. If this comes along, what is to be the effect on the R. O. T. C.?

Dr. Mann: I wish I could answer that, but I can't.

President Howe: I don't know that Dr. Mann would answer this question, but I would like to know whether the colleges which have Army officers assigned to them are expected to pay those Army officers something in addition to what the government pays them. I am asking that because we have had a Major of the Regular Army assigned to us and he has practically demanded $1,000 a year from us in addition to his salary as an Army officer. We don't object to paying him at all; we object to the demand. We voted to pay it before the demand came. Then he practically insisted upon it and wanted a telegraphed reply after he had been ordered by the government to come to our institution as to what we would do about it.

Dean Bishop: Is he retired?

President Howe: Yes.

Dean Bishop: Then he has a right under those conditions to expect additional pay. If he is an officer in active service before being ordered to your institution, then he is not entitled to receive anything except by special act of Congress. With a retired officer it is a little different.

Dr. Mann: I was surprised a day or two ago to know that a letter had been sent in from one of the schools in reference to an officer as to whether they might pay him additional salary. My impression was just what Mr. Bishop has said. If he is a Regular Army officer on active duty, he can't receive money.

President Howe: Aren't all these officers, when they are

sent to an institution, placed on active duty with full pay when they are sent?

Dr. Mann: I don't know that they are.

President Howe: I have been told by some of them that as soon as they receive orders to go to an institution they were on full active duty and received full pay.

Dr. Mann: I think it is a very bad policy myself. I had a look-in the other day on the situation in the Adjutant General's office in reference to a case like this. A school wrote in suggesting that they be allowed to pay an officer additional salary. That was a terrible temptation.

President Howe: We wanted last year to get the regular engineering officer stationed at Cleveland to deliver lectures to our students. The major said he would be glad to do it if the Secretary of War would allow it. I wrote to the Secretary of War and asked him if we might pay the major for giving these lectures. Secretary Baker wrote to the major personally, allowing him to give the lectures, but reprimanding him for demanding extra pay. Of course, I wrote to the Secretary and said that the proposition of paying him extra was mine and did not come from the officer.

Professor Allen: I have this spring had occasion to investigate conditions in the high schools of the State, and I find a large number of the high school students are enlisted, so our attendance in the engineering schools will be very much depleted this fall. If the committee is going to keep up our normal size of classes, it will have to do something in regard to high schools.

W. J. Risley: In the medical schools they are enrolled, called deferred, and a button or something is given so that the man is definitely tagged as enrolled in the government service. Is it not also about what the government has proposed, Dean Richards, to do with engineers who are enlisted in the service and then have deferred calling?

Dean Richards: They haven't proposed anything constructive yet.

Professor Risley: I saw something like that in the Congressional Record.

Dean Richards: Nothing like that has been settled as yet. I am interested in the paper and in the questions asked. I have been growing more concerned as the year has gone by over and over the ever increasing demand for engineering students on the part of the Army, the Navy and the industries, who come along at the tag end and take what is left, the physical misfits and that sort of thing. I haven't as yet seen anything very hopeful in the whole situation. I don't believe that any branch of the government service has as yet realized the seriousness of the situation or if they have realized it they have made no attempt to maintain the supply of technically trained men.

Something was said about the safeguarding of teachers. That has been presented time and again to the War Department, but so far nothing has been done to preserve these men for the work they are best fitted to do. I took the liberty a few days ago to send a letter to the Secretary of War, urging that he give some thought to the problems of technical training and giving my views concerning the action so far taken. I don't think that the provisions made last December for the enlistments of students in the Enlisted Reserve Corps of the Engineering Department have been very successful. In the first place, they have set so high a standard that if one lives up to the regulations, as we have attempted to do in Illinois, a comparatively small percentage of the students of draft age are able to qualify. I am sympathetic with those students who are not able to maintain high standing at the present time, because it is hard for every one of us to keep our minds on the main job. The regulations for enlistment in the Engineer Enlisted Reserve Corps do not provide for any uniform or other insignia to distinguish these enlisted boys from other students. Many persons have regarded this form of enlistment as a device to prevent students from being drafted at a particular time. General Black looked upon it as a sort of slackers' corps.

In my opinion we should reduce the requirements so that any student who is doing acceptable work will be permitted to enlist in the Engineering Enlisted Reserve Corps. Whenever he fails to do acceptable work, he should be immediately ordered into active service. In other words, the students' standard of performance must be kept up.

Furthermore it seems to me that these students, instead of being placed on the inactive list, should be considered as detached duty in the active service of the Army. If the boys consider that they are in some active work which is absolutely essential to the successful prosecution of the war, I think they will go about their work with greater energy and enthusiasm.

I have talked to a good many students during the past year, and I find that nearly all of them feel they must get into some of the active fighting branches of the service—that they will be called "yellow" if they should undertake to do non-combatant work for which their training best fits them. As a matter of fact, however, there are few, if any, branches of the service which require no technically trained men. A few days ago the Director of Technical Instruction of the Coast Artillery Officers' Training Camp, hoping to interest some of our men, said: "We must have technically trained men for artillery officers." So it goes with all branches of the service. There is no branch in which technical training does not play some part.

I think the most drastic suggestion I made to the Secretary of War (and I am rather interested in what Dr. Angell said, because I expect it is another way of getting at the same thing) was the drafting of a certain percentage of high school graduates for advanced technical training. I use the term "drafting" in the same sense we use it in the Army, that is, taking the man whether he has any particular intention of going to college, and sending him there. I do not think that these suggestions are unreasonable.

I was talking to a prominent engineer this morning and discussing some of these problems. He said, "Where do the industries come in?" I said, "Until the government realizes

more fully the importance of conserving the technical schools than it seems to do now, the industries are not going to come in." Most of the boys feel they must get into active service in the Army or Navy. I hope in the end that something constructive will come out of it all.

I do not think this discussion has a very direct bearing on the paper, but it is a good time to get the matter out of the system of the men here, so I am going to take the liberty of telling how we did it at Illinois.

We desired to observe the rules religiously, as we interpreted them. We found that we had about nineteen hundred graduates during the past ten years. We actually took the average of the record cards of these nineteen hundred young men and established the fact that eighty-five and nine tenths was the minimum academic record of the student in the upper third of that group. We then adopted the suggestion concerning the army's rating scale which the committee sent out, and each student, we decided, must have an average grade at least eighty-five and nine tenths, and, in addition, fifty points on the personal rating chart which had been adopted for the selection of candidates for the Third Reserve Officers' Training Camp.

We found that occasionally a student would get an unusually high personal rating, eighty or eighty-five out of the possible one hundred, but that he would fall slightly below the scholastic average of eighty-five and nine tenths. In such cases we assumed with that we might properly certify a student who was not more than one per cent. below this average grade. That was as far, however, as we were willing to go.

As I said before, the students at the present time are not making the such good grades as they formerly did, though I suspect the instructors are marking them somewhat more liberally than before the war.

Dean Anthony: One more word in regard to the original reserve regulations. I do believe it was the only thing that could have been put through at that time, knowing as I do pretty fully the obsessions from all quarters, not the least of

which was from the American Society of Mechanical Engineers.

Director Hayford: I would like to interject right here, for fear that what I said earlier may be misunderstood, that while I have been interpreting this paragraph exactly as some others have interpreted it, to mean what it says, and have been very much disappointed with the outcome, which seems to me to take the upper one third only. To be perfectly fair we ought to recognize that we had at Washington as representatives of the engineering educators men who worked very hard, very energetically and very skillfully to get this through as we have it. Even if we are disappointed, we ought to recognize that they had an almost impossible job and they got what they could.

Quoting from the last paper, "Technical men cannot be trained in less time than is usual in the engineering colleges now," I presume this means four years. I agree heartily with that. I may be pessimistic in looking for trouble that isn't coming, but I feel that I should sound a warning. You have all heard the story of the old man who gave as his last words to his sons: "Boys, I have had a lot of trouble in my life and most of it never happened."

This thing I am going to tell you about may never happen, but it seems to me that when our colleges are being used to a large extent for vocational training we are going to yield to a certain extent to demands for shorter courses. One of the residual effects of that is going to be a feeling on the part of many people that after all one can give engineering education in a short time. There is going to be a downward drag, tending to lower our standards of engineering education. We ought to recognize this vocational training and these shortened courses as emergency matters only. Let us remember that the Germans had greater success in this war man for man than the Allies because of their habit of thoroughness in engineering as well as in other things. If we learn from the Germans, we are not going to give shorter or lower grade engineering courses after the war than before.

We are going to raise the grade of engineering education as a result of the war. We will not succeed in doing that unless we begin pretty soon.

Professor Risley: There was another question I had in mind. From what has been remarked by Dean Anthony, it may be more properly discussed tomorrow. It is with reference to the teachers. My own personal view is that five hundred "you's" and "I's" ought to be sent into an officers' training camp, that I, for example, may take the place of one of the three or four of my boys teaching gunnery, about which I don't know anything, and that that shall be done this summer for six weeks, and that we shall be returned as an educated, prepared reserve to take the place of the fellows of draft age when Pershing will need us later, teaching the boys gunnery in the camps, so the instructors of draft age can go to the front.

If this is not the time to discuss the subject I would not suggest it, except that teachers of engineering were spoken of. If Dr. Mann is to come with some other papers, or perhaps there is some other better place to have that discussion if there is, I should like to see it brought up there.

That is my personal opinion of what we should be doing from the standpoint of teachers. None of us, I suspect, know very much about gunnery from a technical point of view. If that is out of order, I should like to have it deferred. If not, I should like to have it discussed, Mr. Chairman.

The Chairman: I take it that the same idea will come up tomorrow morning.

Professor Risley: Very well, I should prefer it to come up then.

REPORT OF COMMITTEE ON ENGINEERING DEGREES.

We beg to submit the following report from the committee appointed February 5, 1918, to consider engineering degrees.

We have been unable to hold a meeting, as our three members are situated at the vertices of a spherical triangle whose sides are 1,010, 440 and 1,445 km. long. We have, however, maintained a triangular correspondence since February 7, and while we have not been able to arrive at unanimity of conclusion, we have reached a condition of mutual understanding which warrants the presentation of a report or reports.

The Society for the Promotion of Engineering Education has already received and published, in 1911, an excellent committee report on this subject; namely the report of the "Committee on Engineering Degrees" adopted at the Madison meeting in June, 1910, and published in Vol. XVIII of the Society's Proceedings, 1911, pp. 135 to 155.

This committee endorses the report of the above mentioned 1910 committee.

Since 1910, there has been published in America one other report on the subject; namely the report in 1917 of "The Committee on Academic and Professional Higher Degrees" to the Association of American Universities. A copy of that report is suspended hereto. The report deals with the subject of university degrees in general; whereas the subject under consideration with us is that of applied-science degrees in particular. However, we endorse this 1917 report in the main, certain details thereof excepted.

Referring to page 149 of the S. P. E. E. committee's report in 1911, above mentioned, we quote and endorse the following recommendations:

I. A four-year engineering course should normally lead to

the degree bachelor of science (B.S.), to which should be added a specifying phrase, as for example, bachelor of science in civil engineering.

II. The completion of an undergraduate course in engineering by a bachelor of arts should normally lead to the degree bachelor of science in engineering and not to the Master's degree.

III. The completion of a second undergraduate course in engineering by a bachelor of science should normally lead to the same degree, bachelor of science in engineering with specification of the second branch of engineering, and not to the master's degree.

IV. One year of resident work in graduate engineering work and scientific subject by a bachelor of science in engineering should normally lead to the degree master of science (M.S.) with the specifying phrase, as, for example, master of science in civil engineering.

V. The degrees doctor of philosophy, doctor of science and doctor of engineering should be given for not less than three years of resident work in graduate engineering and scientific subjects by a bachelor of science in engineering, or for not less than two years in case of a master of science in engineering—these degrees implying the definition given above under I and IV respectively.

VI. The professional engineering, C.E., M.E., etc., should be given only to graduates who present satisfactory evidence of professional work of superior quality extending over not less than three years, and who submit a satisfactory thesis.

VII. The same degree, C.E., M.E., etc., may be given to engineers as honorary degrees; but great care should be exercised in awarding them.

VIII. The degree doctor of engineering, historically an honorary degree, may properly continue to be so regarded, though it is believed that as the work of engineering schools is extended, and the granting of the degree in course becomes more frequent, its use as an honorary degree should diminish.

IX. Professional and honorary degrees should in general be different from those which are given in course.

In regard to recommendation no. V, on the doctorate degree, this committee considers that the degree of the doctor of science is to be preferred, in view of the proceeding degrees of bachelor of science, and master of science. In other words, it seems inconsistant to cap a bachelor's and master's degree of science with a doctor's degree of philosophy. If the degree for the doctorate is to remain the doctor of philosophy, then the antecedent degrees should, in conformity, be changed to the "bachelor of philosophy" and the "master of philosophy" respectively. This committee recommends that action should be taken by the S. P. E. E., looking towards the general adoption of the "science series" or S.B., S.M., and S.D. degrees as the regular degrees in American applied science. Unless concerted action is taken, the procedure is likely to remain diversed and inconsistent, because, in some institutions, the science series of degrees has unfortunately been disparaged.

Our committee does not advocate discouraging the award of the doctor of philosophy as the doctorate degree in unapplied science. That degree has established a widely recognized and highly valued position in American academic life and literature. It is only in regard to engineering and applied science that we recommend the simple progressive series of the bachelor, master and doctor of science degrees.

We believe that if the S. P. E. E. adopts these recommendations and inaugurates an active policy of persuasion towards the engineering colleges and technical branches of universities, the science series of degrees might be adopted almost universally in America in a few years' time.

Respectfully submitted,

A. E. KENNELLY,

C. R. RICHARDS.

REPORT OF COMMITTEE ON ACADEMIC AND PROFESSIONAL HIGHER DEGREES, ASSOCIATION OF AMERICAN UNIVERSITIES.

The recommendations to be made by your committee are based upon the following two assumptions:

A. That is the function of your committee to formulate an acceptable statement of principles regarding academic degrees and the conditions under which they should be conferred. Advice rather than precept is intended.

B. The existing status is comparatively satisfactory as regards the degrees more commonly conferred. The committee understands this status to be substantially as follows:

1. B.A., B.S.,—Conferred after at least one year of advanced work in a graduate school subsequent to absolving the requirements for the B.A., B.S., or equivalent degree.

2. M.A., M.S.—Conferred after at least one year of advanced work in a graduate school subsequently to absolving the requirements for the B.A., B.S., or equivalent degree.

3. Ph.D.—Conferred for advanced work in which independent investigation occupies an essential place. The results of this investigation should be set forth in a thesis worthy of publication. The amount and character of the work should be such that the degree rarely could be attained in less than three years following the attainment of a bachelor's degree or its equivalent.

Adopting as fundamental the degrees thus indicated, your committee has sought to coördinate with them such other degrees as seem needed or useful for academic and professional purposes. Recognizing that professional degrees are in large measure subject to the opinion of the several professions to which they relate, your committee has sought and acknowledges with thanks the receipt of substantial aid from representatives of the American Medical Association, the Society

for the Promotion of Engineering Education, the Association of the American Law Schools.

In accordance with the foregoing considerations, the committee represents the following recommendations:

1. The multiplication of degrees is to be avoided.

2. No degree should be given for attainments less than those of the standard B.A. and B.S., *e. g.*, a two-year or three-year course in music, pharmacy, etc., should be attested by a certificate in music, a license in pharmacy, or other similar phrase.

3. In appropriate cases the B.A., or B.S. degree may be supplemented by a qualifying phrase, *e. g.*, B.S. in agriculture, B.A. in commerce. (On the question of so modifying the A.B. the committee is divided.) Other forms of the baccalaureate degree, *e. g.*, B.L., Ph.B., may be continued for the time being on account of establishing precedent, but it is noted that they tend to disappear. Certain well-established professional degrees, *e. g.*, LL.B., B.D., stand upon a different footing. New baccalaureate degrees are undesirable.

4. A bachelor who completes a second baccalaureate curriculum should receive a second baccalaureate degree rather than a master's degree, *e. g.*, a B.A. who absolves the requirements for a B.S. should receive a B.S. rather than a M.S.

5. *Mutatis mutandis* the recommendations above, numbered three and four, apply to the master's degree.

6. The committee is of the opinion that the subject-matter of the applied sciences or the professions constitutes appropriate fields for research leading to the degree of Ph.D. It finds, however, that this degree does not meet all the demands in the various professions for higher training in research, as contrasted with practice, on the part of students who have already had a professional course preceded by substantial collegiate training; so that for degrees representing advanced research in the various professions it suggests the degree of doctor of science with mention of the progressional field: to wit, D.S. Jur., D.S. Med., D.S. Theol., D.S. Eng. It is understood that these degrees shall not be inferior to the Ph.D. in

standard and dignity. The Sc.D. without specification of field shall be construed as an honorary degree.

7. Professional study beyond that corresponding to a master's degree should lead to a degree, which your committee provisionally calls a practitioner's degree. Satisfactory types of such degree are found in the engineering profession, *e. g.*, civil engineer, mechanical engineer.

Your committee has considered various suggestions of parallel degrees in other professions, such as architecture, public health, forestry, but none of the degrees suggested, such as graduate, licentiate, associate, seem satisfactory, and we therefore ask opportunity for further consideration of the matter.

8. In general, degrees conferred in course should not be granted *honoris causa.* The committee finds that some universities prefer to use the single degree LL.D. as the honorary degree, while others seek to differentiate type of achievement by other distinctive degrees, such as Litt.D., Sc.D, and D.D. Where different degrees are used for this purpose, it is the committee's opinion that the university conferring them should treat all, as of equal dignity and standing.

9. Certain exceptions to the principles above outlined have become so firmly established in practice that they must be regarded as permanent. Chief among these is the degree doctor of medicine (M.D).

10. For the amelioration of such outstanding cases and for the consideration of others that will probably arise, we recommend the creation of a standing committee of the association to observe the development of academic and professional degrees to aid, so far as is feasible directing such development along lines acceptable to the association, and to report to the association from time to time upon the matters intrusted to it. The appointment of such a committee should follow the discharge of the present committee.

11. The committee further recommends that the substance of this report, so far as it is approved by the association, be

transmitted through the proper channels to those professional societies that have coöperated in its preparation, and to such other societies and institutions as my be interested.

A. O. LEUSCHNER,
Chairman,
W. H. CARPENTER,
G. C. COMSTOCK,
C. H. HASKINS,
R. D. SALISBURY.

MINORITY REPORT OF COMMITTEE ON ENGINEERING DEGREES.

BY HENRY S. JACOBY.

My dissent from the report of the majority relates principally to the first or undergraduate degrees, and to the masters' degrees. The first degrees recommended are: C.E., M.E., E.E., E.M. (engineer of mines), Met.E., Chem.E., etc., and the second degrees: M.C.E., M.M.E., M.E.E., etc.

The arguments in favor of these degrees may be briefly stated as follows:

They are simple in form and as distinctive as possible. The greatest diversity in practice regarding degrees has been developed in connection with those forms that are allied to degrees given in arts and science. The average work of students in engineering colleges cannot be placed generally in the same category with that of arts students in the same institutions. The students acknowledge this quite generally. The engineering students work much harder and as a rule are proud of the fact. Where engineering and arts students work side by side in such courses as economics, both teachers and students notice a difference in the ability of the men to handle the subject effectively. The power of analysis and the ability to represent data graphically or otherwise for study or comparison, are noticed to be different in the two groups.

The requirement of a certain amount of professional practice before awarding a degree of the type recommended above is contrary to the general practice relating to all other degrees. Degrees represent academic distinctions and have their primary value in academic life and literature. No claim can rationally be made by the holder of such a degree to the independent practice of his profession on account of that degree. Those holding the so-called professional degrees of

M.D., or LL.B., are required to pass state examinations before being admitted to legal professional practice. No layman or client can properly claim to be misled by such a degree any more than a prospective depositor would be misled by the sign of a bank. Decisions in such matters are based upon more substantial matters than a painted sign.

Degrees imply a certain quantity and quality of intellectual ability, and of academic work, evaluated in accordance with recognized academic standards. In professional practice, all degrees are not regarded as of the same value, for those who employ young graduates often consider other qualifications as well as the institutions from whence they come.

If uniformity in practice in conferring degrees upon engineering students is (finally) to be effectively promoted it is well to consider whether the desired result may not be accomplished more readily by adopting the more distinctive type of degree. If the present tendency to enlarge the common core of all engineering courses of study persists it might emphasize the desirability of giving the same degree to all engineering students, in which case bachelor of engineering would be appropriate in distinction from B.A. and B.S.

ENGINEERING DEGREES IN LATIN-AMERICAN REPUBLICS.

BY H. W. KING,

Professor of Hydraulic Engineering, University of Michigan.

This paper is a summary of an investigation by a special committee of the College of Engineering, University of Michigan, which was appointed to investigate the degrees given by the universities of Latin-American republics, and the standing of graduates of universities in this country who wish to practice their profession in Central and South America. The necessity for such an investigation became apparent after receiving complaints from alumni to the effect that their degrees were not recognized in several of the South American republics, and that they had great difficulty in qualifying for practice in those countries.

Owing to the distance involved and the fact that correspondence had to be carried on in a foreign language, as well as the difficulty of conveying to the other countries the true significance of the committee's work, the information obtained has been rather incomplete and unsatisfactory. Sufficient data were obtained, however, to show the situation in general, and to form the basis of a more comprehensive investigation.

Briefly stated, the problem is as follows: Out of 68 technical schools in this country, to whom inquiries were sent by the committee, 8 give professional degrees upon the completion of a four years' course, 58 give a bachelor's degree for a corresponding course of study, and 13 give a professional degree at the end of five years. All but two of the latter also give the bachelor's degree at the end of four years. Of the colleges that grant a bachelor's degree at the end of four years, it is the general practice to grant a professional degree

after three to five years' experience upon the presentation of a satisfactory thesis.

In the Latin-American republics the above degrees have an entirely different significance than in the United States. Practice is not entirely uniform, but in general the educational system of these colleges is divided into three parts, which may be called the primary schools, the secondary schools, and the universities; each having a course of study of four to six years. Students receive a bachelor's degree upon graduation from the secondary schools. They may then enter the universities, where training in the professions is given. Engineering students receive the professional degrees, corresponding to our degrees of C.E., M.E., E.E., etc., immediately upon graduation from the universities.

A bachelor's degree in the Latin-American republics indicates that the student has received training practically equivalent to that of our high schools, and our students, with a bachelor's degree, who go to these countries to practice are quite naturally placed in the same category.

More importance is attached to degrees of engineers in the Latin-American countries than in the United States. Conditions resemble those for the medical profession in this country. Though custom varies, a professional degree is generally required to practice, or the graduate desiring to engage in engineering work must submit to a rigid examination. In most South and Central American countries, therefore, the students from colleges in this country who receive professional degrees upon graduation are at a distinct advantage over those who receive a bachelor's degree.

The first step in the investigation of the committee was a study of the sentiment of the colleges of this country regarding the possibility of reaching an agreement in the matter of granting uniform degrees following a four years' course of study and later of educating the Latin-American republics as to the exact meaning of the bachelor's degree in this country. There is, however, but little likelihood that there will be any approach to a uniformity of degrees in this country for many

years, and it does not appear that the condition as regards the Latin-American republics would be benefited by a uniformity of degrees unless all colleges adopt the plan of granting a professional degree at the completion of a four years' course of study. As the general sentiment in this country is opposed to this course, there is small possibility of its adoption. The plan of attempting to educate the people of Latin-America as to the exact meaning of the bachelor's degree in this country seems equally unlikely to prove satisfactory. While a few of the educators of these countries understand that our bachelor's degree is practically equivalent to the professional degree conferred by their universities, it is impossible to create a general understanding as to our practice among the people with whom our graduates must come in contact.

The committee was not well informed as to educational matters in the Latin-American republics when it entered upon a study of this subject. It was believed that the authorities in education in these countries might take the initiative and thus bring about a satisfactory adjustment. This will be possible when all of these countries have adopted the policy now pursued by the Republic of Mexico, of furnishing an opportunity for the exchange of diplomas and credentials, which permit engineers to practice. This condition is not creditable to engineering schools in the United States which confer bachelors' degrees at the end of four years. Our diplomas should in themselves stand for something in foreign countries.

It appeared to the committee that an early adjustment of this matter could be obtained only through conforming with the recognized practice in the Latin-American republics rather than in attempting to bring about a general appreciation of our bachelor's degree in these countries. As a temporary expedient, therefore, the committee recommended to the faculty of the College of Engineering, University of Michigan, that graduates in engineering who propose to practice in Latin-American republics, be awarded diplomas containing the phraseology of the degrees that would have been earned had

the students pursued courses in the technical schools of the countries concerned. This question is now under consideration by the faculty, and though the sentiment appears to be favorable to the general plan, the form of diploma has not been decided upon. It has been proposed to issue special diplomas, written in Spanish, to graduates who desire to practice in Latin-American countries upon the payment of a special diploma fee. Such diplomas will have the phraseology of the professional degrees common in these countries and contain an explanatory note to the effect that they are special degrees issued for practice in foreign countries. This will, to a large extent, obviate the criticism that certain students upon graduation, receive the same degree that ninety per cent. of the colleges in the United States believe should be granted only after the graduate has qualified by the successful practice of his profession from three to five years, and the preparation of a satisfactory thesis.

It is believed that this question is of vital concern to all of the engineering colleges in the United States. It affects the students from the Latin-American republics as well as students from our own country who wish to practice in Central or South America. The problem has too broad a scope to be undertaken by any one institution, and it properly belongs to this society, which represents all of the engineering schools of the country. The committee therefore submits the matter for your consideration. A copy of the progress report which contains correspondence and other data obtained by the committee will be turned over to the society. It is hoped that the investigation will be continued and that a uniform line of action may be adopted by the engineering colleges of the country.

Discussion.

W. E. Mott: I would like to ask if the graduates from schools such as Rensselaer, Cornell, etc., who are natives of South America, would experience the same difficulty as our own graduates when they go back there.

H. W. King: Our understanding is that the students who have received professional degrees in this country have a distinct advantage. The University of Michigan has had a number of students from Latin-American Republics, Chile and Argentine especially; it was from these students that this question was brought up. They complained that their degrees did not stand for what they should in their country, that they were not understood and that graduates of other colleges granting professional degrees did have advantages and it was easier for them to practice. Of course, we do not vouch for all the information obtained because it was difficult to get, but as nearly as we can determine the real facts are presented.

W. T. Magruder: I would like to ask if Professor King did not find that the Argentine Republic requires an examination of all foreigners irrespective of what degree they have. I remember that a few years ago at the International Science Congress in Washington that was brought out.

Professor King: I believe you are correct. In Argentine the practice is not the same as in some other countries. There they do require an examination, but graduates receiving a professional degree have a better standing even if they take the examinations.

John F. Hayford: I would like to make a suggestion. We have an organization in Washington which probably might make itself useful in straightening this out—the Pan-American Union.

Professor King: We corresponded with them in getting this information.

A. S. Langsdorf: I would like to ask if I understand correctly the statement that the students who wish to practice in South American countries get a special degree equivalent to the professional degree. At the same time do they get a professional degree in English?

Professor King: A suggestion was made to grant all graduates receiving the Bachelor's degree who wish to practice in Central or South America a C.E., M.E., or other correspond-

ing degree, but the diploma was to be written in Spanish and contain a note to the effect that it is a special degree for practice in Central and South America.

Michigan belongs to the colleges that give the bachelor of science in engineering degree and there is no disposition to change that.

This is a real problem that ought to be met, especially by those colleges that have a large number of South American and Central American students.

Henry S. Jacoby: The report relates to engineering degrees.

The report of a Committee of the Associations of American Universities on Academic and Professional Higher Degrees is attached to this. I have not learned what the President's particular reasons were for appointing this special committee at this time.

I differed with the other members of the Committee in regard to this report, but did not receive it as finally formulated by the majority until I had left home for Illinois. After my return I had to leave soon again to attend another convention for a week before coming to this meeting, thus preventing the preparation of a minority report.

I desire to be given permission to formulate the minority report together with some reasons for it to be submitted to the Secretary for publication.

Perhaps a few words may be said in regard to the report. In the first place, there are objections to the degrees as recommended because the form of the degree as it is always printed in connection with a man's name in a university or college catalog, or in some other publication cannot, in the nature of the case, include the qualifying phrases as recommended, so that as it is printed it would always appear B.S. without indicating that it was in civil or mechanical or electrical engineering or anything else, hence making no distinction between the Bachelor of Science in arts and the one in engineering.

If the series consisting of bachelor of science, master of science or doctor of science were adopted, it would practi-

cally be necessary to use the qualifying phrase in each case. I see no particular reason why doctor of philosophy should not be used because of its widespread use everywhere without any qualification. With the doctor's degree there is less reason for making the distinction than for master's and undergraduate degrees.

I wish to ask two questions which I hope may be answered here. To what extent have the institutions which are represented here taken any action in response to the preceding Committee report which was adopted at Madison in 1910? Has there been any publicity campaign; and has it influenced practice in any respect? Or, is it likely that each campaign of persuasion would secure any results?

The second question is, what percentage of undergraduates who have received degrees of B.S. in C.E., or any other combination, have submitted a thesis of good quality and received a professional degree later? Has that work been carried out in exactly the same spirit as undergraduate work or has it been a sort of form. To state it in another form, what percentage of students never take the trouble to write the thesis and do the work required? Some responses from the floor would be very valuable as a guide for future action.

Professor Jacoby read a letter that was sent to the other members of the committee before he knew that his opinion differed from those of the other members, in order that the attitude to be expressed in the proposed minority report might be known.

The Chairman: If there is no objection we will be very glad to have Professor Jacoby formulate that minority report. Do you wish to discuss either of these reports?

Professor Jacoby: May we not first have some quick, brief responses in regard to the two questions asked? To what extent have institutions made any changes whatever in response to the preceding committee report? What percentage of students who get degrees like B.S. in C.E. have completed their subsequent work?

S. N. Williams: Mr. President, answering Professor Jacoby's last question, I might say that my own practice has been to give the degree bachelor of science in civil engineering as the first degree, while the degree of civil engineering is given for not less than three years of professional practice accompanied by examinations and presentation of a thesis. I have found in my own practice that all graduates who had gone into engineering and expected to continue in it, sooner or later within a reasonable time, took the examinations and got the degree, and that omitted, as it should, those who did not take up engineering as a profession after graduation.

W. T. Magruder: Mr. Chairman, I don't desire to inflict my oft-repeated remarks on this subject on you again. Some of you may remember that I have spent a good many hours studying this subject, and have gotten together a good many facts and have written a good many pages on the subject.

To answer Professor Jacoby's first question I may say that one per cent. is about the proportion as I have observed it in engineering.

I find myself absolutely opposed to the majority report simply for the reason that I am not ancient enough or medieval enough to continue to believe it. I know of only two institutions in the country that any longer follow the practice of giving the engineering degrees of S.B., S.M. and S. M. and S. D., and in Latin. Consequently, I have no desire to go back to medieval practice and do not propose to ask that you gentlemen shall talk Latin in order to be understood by me.

I do not like the use of the degrees of bachelor of science and master of science for engineering work. I have no objection to it for pure science, but I object to it for engineering because it is inaccurate. You are not a bachelor of science when you have studied only applied science. If you are an engineer, be accurate.

I like the term bachelor because a bachelor is only a novice as defined by custom and the dictionary. If a man is a novice in civil engineering or mechanical engineering, or whatever

the subject may be, the term "bachelor" covers the case and is well understood. The terms bachelor, master or doctor may be artificial, but they are at least accurate statements of what you think are the facts.

In diplomas, catalogs, and on the title pages of books, the abbrevation for the degree is usually printed "B.S. in C.E." It is used that way in colleges east of the Alleghany Mountains. In colleges west of the Alleghany Mountains it is written "B.Sc. in C.E." Why educated people persist in putting that "c." in in the abbrevation for science I do not know; perhaps to help the memory that "Sc." stands for "science," and not "S" for "something."

If you as engineers were required to write a specification for this subject, what would you do? You would make it accurate, definite, positive and you would make it specific.

I, therefore, recommend "B.C.E." for the first degree in civil engineering. That tells the truth, the whole truth and nothing but the truth. He is a novice in the general subject of civil engineering. But if he has specialized in civil engineering and proposes to go into railroad, bridge or sanitary engineering, and you think it proper to be still more specific, say so and grant the degree of bachelor of sanitary engineering, or the like. If you do not want to be so specific give him the general degree of bachelor of civil engineering.

To answer the minority report—Professor Jacoby being from Cornell University naturally stands for the Cornell practice. That is good loyalty, I commend it. There used to be a number of institutions which gave the professional degree as a first degree. I received one. When I received my degree, I had probably read fifty per cent. of the literature in mechanical engineering. Today I think I may have read five per cent., because the mass of literature is so much greater and the subject has increased so much in breadth and scope. Hence, I do not believe in the conferal of the C.E. degree as the first degree. The M.E. degree as a first degree is a misnomer; it is inaccurate, untrue and confusing. The fact is that it is misleading and deceptive to many people.

You say you are not responsible for their misunderstanding of the thing; possibly so, but the fact remains that you have received them.

J. C. Nagle: I want to say that twenty-eight years ago when I first went to our institution we used the last designation, bachelor of mechanical engineering, of civil engineering, etc., but perhaps eight or ten years after that, finding ourselves almost alone, or in the minority in the use of that designation, we changed it to the third form B.S. in C.E.

My objection to using the term civil engineer and mechanical engineer lay largely in the character of the courses we were able to give with the preparation of the students coming to us, and the designations were not comparable to similar degrees given in other institutions. We use the term B.S. in civil engineering, and for a year's graduate work in residence and the presentation of a thesis, we confer the second or technical degree.

To answer Professor Jacoby a little further I should say that perhaps not over five per cent. of our men who take the first degree take the second.

W. E. Mott: At the Carnegie Institute of Technology we have had occasion to make an extended study of the report of 1910. It seems to me that the response of the Society to the recommendations of that report shows clearly that sentiment is overwhelmingly in favor of the second group of abbreviations.

We are using the second group and are convinced that it represents the best prevailing custom. Our second choice would probably be the last group if we did not follow accepted practice. Personally, I do not like the first group and agree with the remarks of Professor Magruder. Further, I absolutely agree with his statements in reference to the minority report.

I may add that not over four per cent. of our graduates come back for the advanced or professional degree.

A. S. Langsdorf: Mr. Chairman, the report that has been presented is in accord with the practice that has been fol-

lowed in Washington University for a considerable period, not less than fifteen years. Prior to that time there had been numerous changes in the degrees conferred, five or six different ones having been awarded within the period from 1870 to 1892. At the present time our degrees conform to the third list on the blackboard, namely, those of the type B.S. in C.E.

Answering Professor Jacoby's question as to the number who apply for the professional degree, our experience indicates that it is in the neighborhood of five per cent.

To answer the other point made by Professor Jacoby, I would say that some of us who were at the Madison meeting will remember it was a very hot discussion and on a very hot day, and was not fought out to a finish.

Professor Magruder: The objection we have in the Middle West to the bachelor of science degree is that it is a second rate degree in many colleges as compared with their B.A. degree. It is not a very pretentious degree. It lacks class unless the subject is added and also the name of the institution.

G. C. Anthony: Mr. Chairman, it just occurred to me that this final suggestion was the first used at Tufts when an engineering school started. It was afterwards abandoned for the bachelor of science degree and later for the bachelor of science in civil engineering.

My own feeling now is almost in accord with Professor Magruder's, except that I would drop out the designation of the different departments.

L. M. Hoskins: Dean Anthony has said that our specifications for degrees ought to be precise and exactly descriptive. That suggests what I want to say. When Stanford University was established the ideas that prevailed were somewhat radical and a single degree was adopted for all who fulfilled the four year requirements. That included engineering departments.

We have what we regard as efficient departments in civil engineering, mechanical engineering, electrical engineering,

etc., but the degree which is given in all cases is the degree of bachelor of arts in civil engineering or in mechanical engineering, or whatever it may be. That is a position which was regarded as radical. I am not sure it has been adopted by anybody else, but the reason for it I think is this: The requirement that a degree should, by its name, be exactly descriptive is by us regarded as an impossible requirement.

I think if you will look back twenty odd years you will find the multiplicity of degrees which were established with the intention of fulfilling that requirement that the specification should be exactly descriptive are somewhat startling. I think we could now probably name a large variety of degrees which have been adopted with that end in view in various institutions.

The attempt to make our specifications exact and descriptive is bound to result in failure. The degree of bachelor of arts is not a descriptive degree. What do I mean by that? Arts covers the whole ring. We have been interested on the technical side and have met this question in friendly controversy with our brethren on the so-called Arts side, and we have been ably assisted by those in pure science.

Our opinion in the matter I think is the present prevailing opinion, namely, that the bachelor of arts degree is as descriptive of what the graduate in engineering has accomplished as it is of the so-called graduate in arts.

Looking over the course which has been taken by these various classes of graduates, certainly bachelor of arts does not describe the degree in any specific way.

We believe that a course in engineering is ordinarily, from point of discipline and mental attainment, fully on a par with a similar course in so-called arts.

A certain practice was that there was a tendency to place bachelor of science on a lower grade than bachelor of arts. So far as we are concerned there is absolutely no such issue recognized by us.

As regards the B.C.E. degree, I think some of those who

are versed in the history of Cornell probably know that that was in use at Cornell. I am speaking now from information.

F. P. Spalding: Mr. Chairman, there is one point that perhaps might be mentioned in connection with this; it has not been brought out prominently. It is the fact that the tendency in our present curricula is toward less differences between the various engineering courses and the making of work more general and more alike for all of the different men, in so far, at least, as a four year course is concerned. For that reason it seems to me that there is too much distinction in having so many degrees.

In revising the degrees at Missouri recently, B.S. in engineering was adopted as the fourth-year degree in all of the engineering courses. The curricula were changed in such a way as to make a more general foundation for subsequent engineering training by including more work in all of the departments that would be required of each individual, something on the order, perhaps, of Professor Mann's suggestion for uniform work up to a certain point. The differences are small and becoming less. There seems less reason for having the separate degrees, bachelor of science in civil engineering, mechanical engineering, etc., the degree simply bcoming B.S. in engineering.

Professor Williams: Cornell College formerly gave four degrees—bachelor of arts, bachelor of philosophy, bachelor of science and bachelor of civil engineering. In justice to the institution I should say that they have received new light and give now only one degree and that is bachelor of arts for all courses.

John F. Hayford: Some of you may remember that when the report on honorary degrees was turned in in 1910 we had not decided on the engineering degrees to be awarded here at Northwestern. I tried hard at Madison to get the committee and the Society to tell me what the degree should be here. Perhaps because I had a little Irish in me, persisted that they decide that for us. The then president ruled me

out of order and I could get neither the committee or the Society to give me any light.

We then proceeded to act on our own opinions. After looking through the whole maze of engineering degrees we made our decision.

It seemed to us that the fundamental idea was that a degree which is a general training degree ought to be the old traditional degree,—B.S.,—and that for an engineering degree the essential point is to make it show clearly that it is engineering degree. The college of liberal arts gives the B.S. degree to our students when they meet their requirements,—which is normally at the end of the fourth year. By that time they have met the B.S. requirements of the college of liberal arts with a very large amount of excess and the college of liberal arts, not the college of engineering, gives them the B. S. degree. At the end of the fifth year we give them a straight engineering degree. We try to indicate clearly that it is an engineering degree. Since from a student's point of view, he has gone one stage beyond the bachelor stage, it is not labeled as a bachelor degree in engineering. It is C.E. or E.E.

I recognized that the decision was not in accordance with the general practice, but we could not find anything that would be in accordance with practice and would, to our own minds, tell the truth.

Professor Jacoby: Mr. President, it seems surprising that there was so little discussion of that report. Was it because the people who attended the meeting at that time were so unanimously in favor of that report that they didn't discuss it at all?

Director Hayford: My impression was that the people were so far from knowing what they wanted that they didn't have anything to say.

Professor Jacoby: Did I understand Professor Magruder to say he didn't like the master degree, that when a man had a first degree he didn't thereby become a master?

Professor Magruder: Mr. Chairman, I would say that I

object to the master's degree for one year of strictly college work without a professional work. I think the student ought to have some practice because I believe engineering is an applied and not a natural science or a pure science.

To answer the other point I would say that some of us at the meeting at that time will remember it was a very hot discussion and a hot day, the thermometer registering about 95° and the president telling us to sit down very rapidly.

Professor Jacoby: I realize that we have an increasing number of married men who get the degree, and bachelor would not be appropriate for them.

In regard to the remark made by Professor Magruder with reference to my loyalty to Cornell, I wish to say that if this Society can secure fair unanimity in developing a series of degrees or a single degree that shall be fairly distinctive, that shall perhaps not tie itself up with the arts departments, I shall be very glad to do anything I can to bring it about.

Furthermore, if those who are present here think it would be better for me not to make a minority report but simply to introduce a discussion, I shall be very happy to do that.

A. C. Lanier: Mr. Chairman, we should give some weight to the opinion of practicing engineers relative to the significance of the bachelor's degree in engineering. The practicing engineer does not, I believe, recognize any vital differences in attainment between bachelor graduates in the various major fields of engineering; he expects of such a graduate a thorough fundamental training in engineering.

The young graduate is apt to go into any one of many special branches of a major field of engineering, or he may shift from one major field to another; such being the conditions, there is danger of losing valuable time in seeking an accurately descriptive name for the degree granted, time which might be devoted to questions of intrinsic merit. A rather general and flexible name for the degree is to be preferred since its real significance lies in the inference of a training that is broad and fundamental in character.

E. J. McCaustland: It appears to me the discussion does not touch the real point at issue which is the significance of the first degree.

The bachelor's degree means only that a student has completed four years of college work and we ought not to try to read into the degree itself any further specification than that four years of college work has been completed. An A.B. from Harvard and an A.B. from Stanford may mean entirely different things. The "B" means that the student has completed four years of college work and the degree as a whole does not pretend to be more specific than that. If we desire further information we must look up the curriculum on which the degree is based.

At the University of Missouri we give the degree of bachelor of science in engineering for five distinct curricula, which, however, are practically the same for two and one half years, thus following closely the suggestions made by Dr. Mann. Our degrees for the fifth year are specifically professional degrees. Our plan has been under way for so short a time, however, that we are unable to judge of the percentage of students who may take the additional year.

REPORT OF SPECIAL COMMITTEE ON ECONOMICS.

At the meeting of the Society, held in Washington last year, the undersigned were appointed a committee to consider the proposition suggested by Dr. Waddell,—that the Society appoint a committee to prepare a treatise on the economics of engineering, which should treat of the economics of design and construction for all the various lines of engineering.

It was suggested that if the Society "should favor having such a treatise prepared under its auspices, a publisher could undoubtedly be found to finance the undertaking and issue the work at his own expense, preferably without paying any royalty, in order to keep the selling price down to a minimum."

Our committee has considered this suggestion, and begs leave to report to the Society that it does not recommend that the Society undertake the preparation of such a work, for the following reasons:

1. The subject of economics in design and construction is without question a very important one for the student of engineering to consider; indeed, economy should be an element throughout his study of design and construction. But the different branches of engineering stand largely by themselves with reference to this subject, and the subject of economy in construction and design is best considered in connection with each individual subject, and best treated in books relating to each individual subject. The engineer must be to a large extent a specialist; if he wishes to investigate subjects connected with the economics of railroads he does not care to have that subject combined with the economics of bridges or of water works; he would prefer to find it in a treatise on railroads, or in a separate treatise on the economics of railroads. The same is true with reference to each branch of engineering. There seems to the committee to be little occasion for the compilation of a hand book on this subject.

2. A book should be, in general, an individual performance. Even in the case of a hand book it is generally best to have a

single editor to supervise and direct the whole. The preparation of a book through the agency of a committee does not seem wise.

There are already several books on the economics of railroads. If another one is desirable it seems to the committee best to leave the preparation of such a work to individual initiative, subject to the usual financial arrangements with publishers. The same is true with reference to the other branches of engineering. The preparation of any work should not be undertaken lightly, but is a serious undertaking. Any capable man, contemplating the preparation of such a book, will consider the probable demand for it, the expense of its preparation in time and money, and the probable royalty which he will receive.

3. The committee does not believe that there will be a great demand, particularly under the present war conditions, for a composite hand book on the subject suggested. It would not be easy to induce the proper men to write the several chapters, and they should not be expected to be willing to give the time necessary, without the prospect of some return,—which would be open to them if they should undertake independently the preparation of such a chapter or book, in the usual manner.

In other words, the committee believes that this subject should be left to individual initiative in the usual manner, and that coöperative work in this case and under present conditions, is not desirable. If the Society believes, or if any members believe, that a chapter on any branch of economics of engineering is demanded, the proper man can be encouraged to undertake the preparation of such a work on his own account, in the usual way, and the result obtained without expense or trouble to the Society or its members, if a publisher can be found who will publish the book.

Respectfully submitted for the Committee by the Chairman,

GEORGE F. SWAIN,
C. FRANK ALLEN,
A. L. WILLISTON.

June 20, 1918.

REPORT OF COMMITTEE NO. 11-A, PHYSICS.

The Committee on Physics recognizes and very much regrets the lack of coöperation between the two courses, namely physics in the sophomore year (usually) and mechanics in the junior year (usually). It realizes that this lack of coöperation is due, at least in part, to misunderstandings that exist and can be removed. But the building up of a desirable coöperation will be a matter of years rather than of months. In order that definite progress in this direction can be made the Committee on Physics thought it wise to undertake with the Mechanics Committee the coöperative preparation of a syllabus on Mechanics, but it is obvious that a syllabus, in the strict sense of the word, comprises not only content of the subject but the order of presentation.

In order that discussion as to the matter of presentation should not be confused with discussion as to content, the Committee on Physics has prepared and has submitted to the Committee on Mechanics a twenty-three page document entitled "Content of the Physics Course in Mechanics." This "content" is arranged alphabetically from "acceleration" to "work." Under each heading is indicated the extent of the mathematical equations required and there are presented also actual problems illustrating the nature of the problematic work done in the course in physics in mechanics.

This report of the Mechanics Committee was submitted December 6, 1917. It is expected that that committee will either add to this "content" the additional work that is given in this course in mechanics in the junior year, or that it will prepare a similar one, covering only that course. Up to the present time, doubtless due to the war conditions, the Committee on Mechanics has been unable to make a report.

The Committee on Physics believes that in order to secure coöperation definite understanding is essential, and that the work that has been undertaken is the first step that should be made in this direction.

Respectfully submitted,

G. W. STEWART,

Chairman.

REPORT OF COMMITTEE NO. 12, ENGLISH.

In continuation of the committee's work for this year, the following questionnaire was sent to teachers of English in one hundred technical colleges in the United States:

TO THOSE WHO ARE INTERESTED IN THE TEACHING OF ENGLISH TO ENGINEERING STUDENTS.

Committee No. 12, Society for the Promotion of Engineering Education, has received instructions to continue the study of the present status of instruction in English for engineering students.

In carrying on its work of investigation, the committee seeks the coöperation of all who are interested in this phase of the engineering student's training. It is believed that the time has come for a new and a definite statement of the place English should have in the general scheme of engineering education. During the present year, by reason of their new relation to the War Department, engineering colleges have been given increased responsibility as well as added prestige. Many of them have already begun to scrutinize their curricula and to weigh the respective claims of the various subjects now scheduled. The forthcoming report of the Carnegie Foundation for the Advancement of Teaching will serve both as a guide and as a stimulus to further self-analysis, and will evoke a general discussion of the relation of each subject to an entire program of professional training for engineers. The committee feels that teachers of English, along with teachers of other subjects, will be benefited by this challenge for a restatement of their point of view, and for a vindication of the claims of their particular branch of study.

As a modification of the usual questionnaire, the committee has adopted a plan, which, it is hoped, will elicit a more complete expression of experience and opinion than is possible in

a tabular arrangement of questions and answers. Recipients of this letter are requested to indicate on the enclosed duplicate, pages 214 and 215 from the Proceedings of the Society for 1917, the following information:

PART I.

1. *English as a guarantee against illiteracy among college graduates.*

a. Typist English: review of elementary grammatical and mechanical forms, to make up for inadequate preparation of entering students.

b. A constant check upon the writing of students during their course, in order to cultivate habitual correctness of form.

c. Heavy penalties for mistakes, and refusal of degrees to incorrigible illiterates.

d. Reading and study of literature, especially the classics, chiefly for the sake of familiarity with what educated people are expected to know.

(It will be noted that this division is intended to protect the reputation of the institution as much as to aid the student. It will also be evident that (*b*) and (*c*) require the coöperation of technical departments.)

2. *English as training in thinking.*

a. Rigorous drill in exposition, especially in definition and analysis.

b. Briefing and writing of argumentative compositions.

c. Developing the student's constructive imagination.

(See Professor C. A. Smith's recommendations.)

3. *English as a tool for use in technical work during and after the college course.*

a. Note taking.

b. Writing of reports.

c. Writing of technical papers for student societies.

d. Writing and criticism of technical articles.

e. Writing of business letters.

f. Oral presentation of technical matter, including both prepared and impromptu speeches.

4. *English as a groundwork for effective expression.*

a. Reading and study of masterpieces of English literature, in order that their literary quality and technical excellence may influence the student's own style.

5. *English as a link between the professional and the human interests of the student.*

a. Reading and writing of essays interpreting the work of the engineer and explaining the larger meaning of his industrial environment.

b. Reading and criticism of contemporary fiction and poetry which express the spirit of the age.

6. *English as a cultural and recreational escape from the monotonous literalism of vocational study.*

a. Literature studied as literature, with emphasis on its æsthetic values.

b. Reading for the sake of enjoyment, diversion, appreciation. (Far from attempting to show the connection between literature and the engineer's vocation, this type of instruction demands that he forget his profession entirely for the time being and lose himself in a totally different atmosphere.)

a. What aims of English teaching, if any, do you omit from the list given on these pages?

b. What aims, if any, do you add to this list?

c. What is the approximate percentage of time allotted to each division?

It is assumed that replies to these questions will be based on conditions as they actually exist, and not on an improved or ideal arrangement toward which a given institution may be working. For example, an instructor may feel—and rightly—that aim No. 1, dealing as it does with elementary English, should be taken for granted as a part of the student's entrance requirements, although, in actual practice, this division may require from ten to twenty per cent. of the total time given to English. At the same time, the committee wishes to include

suggestions for improvement, both in the distribution and in the methods of presenting the various phases of English instruction. In addition, therefore, to the above brief statement of what is being done, you are invited to give a fuller statement of your experience, and an outline of your recommendation on as many as possible of the following subjects, and on kindred topics concerning which you have something to say.

PART II.

(Please use a separate sheet of paper for each topic.)

1. A Well-Balanced Course in English for Engineering Students.
2. Elective Courses in the Engineering College.
3. Oral English in the Engineering College.
4. Making Correct English a Habit.
5. English as Training in Thinking.
6. Developing the Engineering Student's Constructive Imagination, through Instruction in English.
7. Technical Applications of English for Engineering Students.
8. Literary Composition in the Engineering College.
9. English as a Study of the Human Side of the Engineers' Profession.
10. Literature as a Reflection of the Time-Spirit in Science and in Industry.
11. "Mere Literature" in the Engineering College.
12. Entrance Requirements in English for Engineering Students.

Realizing the extra labors which most instructors are now performing in connection with the war, the committee will be all the more grateful for as full and specific a discussion of one or more of these topics as you find possible. Kindly forward replies to Part I. to reach the chairman not later than May first. The committee will be glad to have an early contribution dealing with some phases of Part II. and to receive further suggestions later at your convenience.

Signed, COMMITTEE.

Complete figures on the referendum in Part I. are not available at the time when this manuscript is sent to the printer. The following data from a tabulation of the first twelve reports may be of interest, as suggesting an average proportion of time given to the different aims in the teaching of English to engineering students.

1. *English as a guarantee against illiteracy among college graduates.* (23.3 per cent.)

2. *English as training in thinking.* (25.5 per cent. Omitted by one.)

3. *English as a tool for use in technical work during and after the college course.*. (23.3 per cent.)

4. *English as a groundwork for effective expression.* (10 per cent. Omitted by three.)

5. *English as a link between the professional and the human interests of the student.* (11.6 per cent.)

6. *English as a cultural and recreational escape from the monotonous literalism of vocational study.* (5 per cent. Omitted by six.)

An interesting addition to No. 6 made by one institution is a *cultural course in general information.* This course, the material of which in a number of other colleges is treated under No. 2, is outlined as follows:

Exposition of an idea: Popular government.
Criticism of the permanent peace program.
Emancipation of women.
The meaning of Christianity.
Democracy and education.
The meaning of "Social Justice."
Evolution.
The idea of progress.
Ethics.
Culture.

This is one of several suggestions that the course in English shall acquaint the student with a definite body of non-technical information and shall stimulate his thinking on political, economic, social, æsthetic, and ethical subjects. Indeed, the

most conspicuous modification of the "standard" course in English just now is in this direction. The theory underlying the change seems to be, first, that along with his technical studies the student should acquire a maturity of understanding in the larger human interests outside his special field; and second, that direct encouragement is needed in order to develop a proper appreciation of these problems. The responsibility and the opportunity of presenting this material falls to the instructor in English, partly because it belongs to no one else, and partly, also, because he is in the best position to arouse interest in human issues and to measure student reactions to them. Thought-provoking material of this kind commends itself especially to the teacher of composition, since it induces natural and spontaneous writing.

Most of the specific data gathered by the committee this year will doubtless be chiefly interesting to teachers of English. The committee hopes to present in a forthcoming report a digest of concrete recommendations which will be directly useful in the teaching of English to engineering students. For technical men in general, the questions of aims, methods, and emphasis outlined in the first part of the questionnaire will, it is believed, prove more interesting and more suitable for discussion at a meeting of the Society.

Respectfully submitted,

C. W. PARK, *Chairman*, Univ. of Cincinnati.
FRANK AYDELOTTE, Mass. Inst. of Technology.
CHARLES ALPHONSO SMITH, Annapolis Naval Acad.
C. F. PARK, Mass. Inst. of Technology.
J. R. NELSON, Univ. of Michigan.
PHILIP B. MCDONALD, Univ. of Colorado.

DISCUSSION.

J. R. Nelson: I think no elaborate presentation is necessary because you will find the report printed in full. Most of you have received copies before you left home. Early in the year the committee sent out a questionnaire, which I think some of you will recall, for the purpose of determining, in the first

place, what was the relative emphasis which, in your own mind, you placed upon the various aims which may be assumed to inspire the teachers in our English colleges. Those aims, if I may recall them to you, were outlined in the questionnaire. You were asked to reply as to the emphasis you placed on the teaching of English as a guarantee against illiteracy, as a training in thinking, as a tool to use in technical work or in college and after college days, as a ground-work for effective expression, as a link between the professional and human interest of the student, as a cultural asset, as a recreation and escape from the monotonous literalism of vocational study.

The second paragraph of our questionnaire suggested a number of topics on which we solicited rather elaborate replies. We simply wished to know which you regard as the fundamental aims and which you omitted, if you omitted any of them, and which you regard as subordinate.

In the second part, directed more especially to the English teachers, we outlined a dozen topics on which we should like to have papers. Some of those papers have been significant and will be published later on in the *Bulletin*.

The time, I know, is limited at these meetings, and the replies which we have received have been so few in number that Professor Park suggested, and I concur with his judgment in the matter, that we should ask you as a group of engineering educators not to discuss the report in detail this year, because we should like to have another year to investigate, but that we should ask you, in the few minutes that you care to give to this discussion this morning, to answer as immediately and directly and positively as you can, two or three questions which are especially interested.

In the first place, what should be our primary aim in the teaching of English to engineers? Or to put it another way—do you regard the teaching of English as a tool or as a humanizing influence which we are going to try to make effective in the life of the engineer himself? Which of those two aims do you regard as the more essential? They are both

perhaps so important that it would be difficult for you to analyze them in part. Upon which, in your mind, should stress be laid?

There is another question in which I am personally exceedingly interested. It was suggested by Professor Mann's paper. It is the matter of coöperation of the technical departments of instruction with the engineering English departments. Absolutely nothing can be accomplished by any department of English in any engineering college unless there is sympathy and coöperation and a sharing of responsibility by all the men who are teaching the students.

The late Professor Earl had an article in ENGINEERING EDUCATION for February, 1917, which I wish some of you who are interested would read. He brings out very clearly, it seems to me, the fact that the responsibility for the training of the student in English must absolutely be shared by all of the men in the engineering college.

I should like to ask then, as my second question, how the English faculties in our engineering colleges can best receive the coöperation of the teachers of technical subjects. In how many different ways can we get that coöperation for our work?

Then, in the third place, I should be very glad, and I am sure the committee as a whole would be very glad, to have suggestions or criticisms which you may have to offer regarding our method of investigation. It seems to me the questionnaire method doesn't always get at the facts. It is rather a difficult thing to handle. Unless the questionnaire is very simple the busy man will not take the time to give it the attention that it should have.

I think perhaps that is all I need to say by way of introducing any discussion. I shall be glad to answer any questions you may care to ask.

J. F. Hayford: Coming to the discussion of this report on English—as I listened to the report one appeal in it struck a responsive chord in me,—the appeal for coöperation of all of the teachers. In that connection I recall a statement in a

report by President Pritchett, of the Massachusetts Institute of Technology, to the effect that if the teaching of English simply develops the ability to write good English when the student is writing themes, but does not result in a habit of writing and speaking good English at all times, it is of little value. I believe the reason why the rest of the faculty must coöperate with the English department, if the teaching of English is to be of value, is that we must force the student to develop the habit of using good English even under the stress of writing examinations and making recitations.

The teaching of English to engineering students is an increasingly attractive field to men devoting their lives to the teaching of English.

The Chairman: I would like to ask Mr. Nelson if the appetite of the senior for instruction in English is as good as the appetite of the freshman.

Professor Nelson: Decidedly so. I think the senior is very much more eager to get the help than the freshman because the courses for seniors are specifically of practical nature. They are chosen when the man is just about to go out into practice. In the report writing course, so far as I can, I insist upon all the assignments for the course being made by the men in the technical departments, so that the reports which come to me are assignments made by the men who can check up on material and the accuracy with which the student has presented his facts. These reports are all handled by the instructor in the technical department and by myself. The student naturally looks upon the thing as a genuine performance.

H. S. Philbrick: This report in English opened up a subject that seems to me might be considered more important than it has been. At the present time we have freshmen and sophomores who bring to us not minds that are empty, but minds that are full of impressions from childhood. Instead of waiting until they get to their fifth year why not begin at the very first place, particularly with English as a medium. Have them make studies of the things that they see; for instance, why is a manufacturing plant in a certain place, why

isn't it in some other city? Then as they go on further they can get more in detail the certain elements of their observations. The English, then, is a tool for handling these things that are vital for engineers. They will learn not only the detail but the general situation and the general relation.

All of this is not an easy thing to work out, but if it increases the interest, as it certainly must, it will be of considerable value.

It seems to me that our discussions have revealed the fact that we are all terribly uncertain about how things are going to go and undoubtedly it is so.

I am convinced of several things and one is that if the pressure is made for us to shorten our courses, we should shorten them. The foundation should be just as deep as ever. I think we should pay as great attention as ever to the foundations. We should try to get as much in as possible in the freshman and sophomore years and do it considerably better. It is a poor time for us to feel that we can't teach any more efficiently than we have taught, and I believe that nearly all of these subjects, including English, can be taught in less time.

Professor Magruder: In the School of Military Aeronautics, at The Ohio State University, we are required to express by numbers our opinions of the efficiency and suitability of the cadets to become Army officers, and it is not unusual for us to say that certain men are not of suitable military material of which to make Army officers. It manifests itself occasionally in the inability of the student to use good English, to conform to rules and regulations, and to manifest the military attitude and bearing. A man may be an expert in flying, but not fit to be an Army officer.

I raised the question, should we not note on our examination papers the derelictions in mentality, aptitude, and education, and relegate to other walks of life those men who show that they are not of suitable engineering material of which to make professional engineers?

Professor Hoskins: I feel like giving my answer to one of

the questions which was asked. The request was made that the discussion should be directed in part to the answering of certain principles. One of the questions was whether the instruction in English should be directed toward the use of English as a tool, whether emphasis should be laid on humanistic values. It seems there could be but one answer to the question as to which of these must be made fundamental. The ability merely to use English is something which is exceptional almost, not only with engineering students, but with those pursuing so-called liberal arts courses. By the use of English I mean the putting together of words which really express ideas in accordance with the simple recognized rules.

All of you undoubtedly in your examination papers very often meet with collections of words which do not express ideas. The student shows that he does not even know what constitutes an English sentence; at least he does not apply that knowledge if he has it.

Without underestimating the value of English as a humanistic study, it must be kept in mind that the first essential is to lay the foundation; and this foundation is the ability to use language correctly for expressing ideas.

The Chairman: Is there any further discussion?

Professor Nelson: May I say a word in closing? I want to add just a word.

I asked the question about the coöperation of the technical men with the English instructors. Three ways have occurred to me as important. One is this: I think that if every engineering instructor were consistently emphasizing the importance of English for the students they would get the feeling that their professors are all thoroughly convinced that English is an important thing for the student to take.

Secondly, I think that if the instructors in the technical courses were willing, even occasionally, to note words misspelled and check them, and would note sentences that fail to begin with capitals, the student will get the impression that those things are important. It would not be necessary either to do this work of criticism with the same exactness and accuracy that is expected of the English teacher.

In the third place, I do think that if the men in the technical departments were willing to coördinate their courses with the courses in English, particularly the technical paper writing and report writing, a great deal could be gained on both sides. I believe you would find that the work in your courses would be more effective because the English men would be working with you to produce good results.

Professor Baker: Mr. Chairman, may I say a few words before you close?

I differ with one word that Professor Nelson said. I think it is every instructor's duty every time he sees an error to correct it,—not occasionally. If he corrects the mistakes only in papers the student will come to believe that there is a poor oral English and a good written English. I think the instructor should correct a student in his oral recitations as quickly as in his written recitations. When that is done a few times he doesn't need to advise the student that it is important, for he will have it ground into him.

G. M. Butler: I want to take exception to the suggestion that it is necessarily undignified or unethical to go out directly to the high-school students personally for our raw material. We hear that suggestion continually and I used to believe that it ought to have weight with us, but I have decided that the opposite is the case. For the last six years I have personally made a visit to the high schools of the states in which I have taught at least once every two years. I have found these high schools exceedingly anxious to have professional men talk to their students on vocational subjects. They welcome anything of the kind very eagerly, and I believe it is our duty to go out and tell these young men of the opportunities which engineering offers, and more than that, to outline for these young men the qualifications necessary for success in engineering so that we shall avoid some of the misfits which come too frequently to us.

If this is done in the proper way there can be no possible exception taken to the practice, and I have found (and I am not speaking personally or egotistically) that these high

schools are anxious to have visits of this kind repeated and to have other departments of the universities, not only the engineering, send such men out.

The men must be chosen carefully. They must be enthusiastic and full of the subject and yet they must be fair. It is necessary that the disadvantages be outlined just as well as the advantages. You must impress the students with the fact that you are speaking fairly and not merely trying to attract them to your university. Tell them plainly that if you haven't the proper courses for them they should go elsewhere where they can secure the best instruction for the line of work for which they are best qualified naturally.

Prepare booklets outlining the things they want to know, and they are these: What the electrical (for instance) engineer does from day to day, from hour to hour, not a general idea of the whole thing, but his daily activities in order that they may ascertain whether they would enjoy following that profession. They want to know what he may expect to earn. They want to know fairly what he may expect to get, what jobs he may expect to receive right after graduation, what his prospects are. That should be stated in terms of normal conditions, not the abnormal conditions existing now. Lastly, and most important, what are the qualifications for success? They can be stated very definitely at the present time.

Prepare little booklets giving this information, distribute them among the high-school students, and I am sure, from experience, that the results will be extremely favorable.

We have prepared such booklets of about fifteen or sixteen pages each, covering mining, civil, mechanical and electrical engineering. I shall be very glad to send copies of those booklets to any one who may request them.

REPORT OF COMMITTEE NO. 14, ECONOMICS.

The Committee on Economics has had no meetings, having found it more feasible to consider the matters assigned to it by means of correspondence. Owing to the press of other duties, Professor R. H. Fernald found it impracticable to serve on the committee, tendering his resignation immediately after his appointment, and no one was appointed to fill his place.

The Society's instructions to the committee were, "To continue the work of the previous committee." The previous committee collected certain statistics concerning the present status of economics courses in engineering schools and recommended that the succeeding committee "prepare a definite scope and content of courses" based on the following topics:

1. A preliminary study in commercial geography and industrial history.
2. Fundamental course in the principles of economics.
3. Application of these principles to engineering.
4. Lessons upon special application in detail engineering work.

The present committee has made a further study of the existing status of economics courses in technical schools, which study is summarized for the three principal branches of engineering in Tables I. and II.

From these data, it appears that about half of the technical schools of the country, taking these forty-two prominent ones as typical, require economics of civil engineering students, and two thirds require it of mechanical and electrical engineering students. Twelve credit hours required of all students is the maximum, and that amount is required at only one institution. A three-credit-hour course seems to be the prevailing custom. Economics is elective or optional in most of those institutions in the above group with zero hours indi-

cated as required, and in a few instances it may be offered for more than the number of required hours. As to the nature of the course, it appears that general principles of economics prevail.

TABLE I.

CHARACTER OF COURSES IN ECONOMICS REQUIRED IN FORTY-TWO LEADING TECHNICAL SCHOOLS.

Nature of Course.	Schools in which Course is Required.					
	Civil.		Mechanical.		Electrical.	
	No.	Per Cent.	No.	Per Cent.	No.	Per Cent.
General economics	21	50	21	50	21	50
Political science	2	4	3	6	3	7
Sociology	1	2	1	2	1	2
Industrial history	1	2	1	2	1	2
Business and finance	2	4	4	9	5	12
Special engineering economics	3	7	5	12	3	7
No course required	18	43	13	31	14	33

TABLE II.

NUMBER CREDIT HOURS REQUIRED IN ECONOMICS COURSE.

Credit Hours Required.			Number of Schools with this Requirement.
CE.	ME.	EE.	
12	12	12	1
0	9	6	1
6	6	6	3
5	5	5	3
4	4	4	1
3	3	3	8
2	2	2	6

In previous discussions of the subject assigned to this committee, a misapprehension has arisen apparently from lack of definition of terms, and particularly from the confusion of two distinct ideas, which are, indeed, the essence of the matter under discussion, namely, *"economics"* and *"economy of construction."* The habit of some writers of putting these two subjects together under the term "economics" leads to a lack of clarity of purpose. The committee understands the term economics to mean "The science of wealth" and to deal with

matters pertaining to the consumption, production, exchange and distribution of the world's wealth as a more or less abstract social science. Economy of construction, on the other hand, should cover those principles of design and construction which accomplish desired results with the minimum expenditure of money, all factors being considered, and is founded primarily upon unit costs, maintenance and life of structures and cost of operation. There does not appear any sufficient reason why these two matters which are so essentially distinct in character should be grouped together in their administration. The four topics presented by the previous committee and mentioned above include two, the first and second, that fall under the term *economics,* the other two pertain more particularly to *economy of construction,* and the present committee has so grouped them.

From the information at hand and after as complete an interchange of views as the limitations of correspondence would permit, the present committee has attempted to formulate recommendations concerning (*a*) the amount of time to be devoted to economics, (*b*) the nature of the course and (*c*) the mode of administration.

The committee recommends that an outline course on economics but no more be required of all engineering students. Engineering has chiefly an economic aspect, that is, it has to do with the production, exchange and distribution of wealth, and the student should become familiar with those general factors which are the framework of society's economic organization and should be led to see how engineering operations are related to them. He should understand that an engineer possesses a training that has economic value and that he will be able to "market his wares" only as he comprehends the economic and commercial organization of society from both the theoretical and the practical viewpoints.

As to the proper amount of time to be devoted to economics in engineering courses, the committee, after considering the factors which it believes should control the arrangement of college curricula as well as taking into account the prevailing

practice, recommends that the amount of time devoted to the formal study of economics be not more than three semester credit hours. The committee is of the opinion that this amount of time will give the student a sufficient outline of the scope, character and limitations of the subject, while, on the other hand, more than that time cannot be devoted to the subject advantageously for the following reasons. Economics is not an "exact science" even with a liberal interpretation of that term, and for that reason largely, engineering students accustomed to studying mathematics, physics, chemistry, mechanics, etc., fail to get the economist's point of view and mode of reasoning and consequently derive very little benefit from an extensive study of economics as a disciplinary exercise. In other words, most of the fundamental propositions of economics are not capable of rigorous and irrefragable demonstration, consequently an extended study of the subject as an exercise in logic may tend toward confusion for the technical student, who is accustomed to less equivocal modes of thinking. The fundamentals of the subject that can be learned in a three-hour course as so much information are sufficient to form a skeleton or framework to which the student can refer his subsequent general reading of a related character. Moreover, owing to the immaturity of the average student's business experience, he has little background for a study of commerce, and for this reason, also, a more extensive study of economics is not considered profitable for engineering students.

With regard to the character of the course, the committee recommends that the subject-matter be similar to the treatment in any standard text on "economics" or "political economy," with frequent illustrations from the actual facts of commercial geography and industrial history, with perhaps a few special lectures on these latter subjects near the close of the course, with a view to calling attention to their more prominent features. Not infrequently time in the lecture room or class room is not utilized to the best advantage because trivial and inconsequential illustrations are employed when illuminating illustrations are available from commercial geography

and industrial history, and it is urged that advantage be taken of such whenever possible.

Special subjects in the economics group, such as accounting, labor problems, public and corporation finance, taxation, money and banking, and others, while possessing much value as information courses, do not seem to deserve a place in the engineering curriculum owing to the already crowded condition of the latter and also because an intelligent technical graduate can read books on any of these subjects understandingly without the aid of an instructor.

It is further recommended that matters pertaining to *economy of construction* be taught in connection with the separate courses to which they are related, the instruction being adapted to the nature of the particular subject under consideration, rather than offer a separate course in economy of construction with a view to making it cover its various phases. However, special lectures and assignments on the economy of construction should be given from time to time. It is believed that aside from a few elementary mathematical relationships between fixed charges, maintenance and operation, and annual costs, the principles involved are not sufficiently general in their application to warrant a separate course in the present crowded condition of the curriculum.

The committee finally recommends that special attention be given to the mode of administering the course in economics for engineering students. In many institutions there seems to be an apathy on the part of the latter with regard to this subject, due perhaps to one or more of several reasons, such as: the sentiment that it is a liberal arts subject and therefore of no value to an engineer; it is not directly applicable in problems of design or construction; economics not being an "exact science" is so different from the student's usual mode of thought that he finds himself in a strange realm; due perhaps to this last condition, there may arise at times a lack of sympathy between the instructor and the student. Whatever may be the cause, this apathetic attitude should be carefully guarded against.

The committee is of the opinion that the subject of economics should be taught to technical students by a professor of economics having a broad education and experience in corporation business. Neither an immature instructor on the one hand nor a preoccupied head of a department on the other should attempt to instruct engineering students, but a man to whom the subject is alive and possesses a vital connection with the commercial world should be placed in charge, otherwise the natural interest of the student will be stifled.

The problem method of instruction has much to commend it as a method of teaching engineering students, due chiefly to the usual mode of preparing their lessons, viz.: by reading a text and solving problems based on the principles expounded therein. A few such problems assigned daily with written solutions prepared in detail required would add interest as well as value to the course.

Summarizing, the committee recommends that a three-semester-credit-hour course in general principles of economics be required of all engineering students, such course to constitute the entire formal study of this subject in four-year courses; that *economy of construction* be taught in conjunction with the separate courses in design and construction, and that special attention be given to the mode of instruction with a view to accomplishing the most definite results possible in the time allotted to the subject.

Respectfully submitted,

A. B. McDANIEL,
W. G. RAYMOND,
G. F. SWAIN,
C. C. WILLIAMS,
Chairman.

REPORT OF COMMITTEE NUMBER 15, COMMITTEE ON CIVIL ENGINEERING.

BY A. H. FULLER.

The subject assigned to the Committee was "Methods and Details of Teaching Structural Design." At first it seemed as though the committee were to consider the methods and details of teaching a well defined subject—*structural design.* As the committee got into the problem it saw there was a difference of opinion in regard to the subjects which should be included under this head. Therefore, it seemed that the *subject matter* was open for discussion.

Recent revision of courses, and talks with engineers and teachers, suggested that the discussion of subject matter should be preceded by some consideration of the *objects* of structural courses. The committee, therefore, decided that in regard to manner of procedure it would prepare certain papers and seek ideas and carefully thought out opinions from other papers and discussion rather than, or at least in advance of, a collection of data through questionnaires. The subjects chosen for the initial papers are:

1. The *objects* of the structural courses.
2. The *subject matter* necessary to carry out these objects.
3. The *manner* of *presentation* of the subject matter.
4. The *training* of *instructors* to carry this out in the most effective manner.

Three members of the committee have prepared papers in accordance with this plan and these have been published in the June BULLETIN.

The fourth was not available in time for advance publication—in fact, it is not yet available. The missing one is on "The Manner of Presentation." I have four or five pages on the subject from Professor Huntington, of Colorado, which he submitted to the committee as a part of the preliminary

correspondence. If it is called for I will read it. It gives some excellent ideas and perhaps outlines what he has in mind to present later.

The committee does not want to encroach on the general field of engineering education, but felt some consideration of it was necessary as a basis for getting down to details.

The committee has the promise of a number of well-known structural engineers in practice to discuss the report, and hopes that any discussion given here this morning may be followed by a more extended written discussion by the members who may be here and many others.

As a basis for preparing the papers and for suggesting a possible trend for the discussion the committee decided, by correspondence in lieu of a meeting, to begin with the following assumptions:

1. Structural design includes the treatment of all static structure whose designs are based on scientific principles and mathematical calculations, therefore including structures of reinforced concrete as well as of steel and timber.

2. The structural design courses are to be considered as a part of the curriculum in civil engineering and must be studied as an integral portion of it and not as independent courses; therefore

3. The work of the committee must include a discussion of the general features of the entire curriculum and go into detail for the courses in structural design.

4. The general curriculum should be fundamental in character and broad in scope.

As these papers are in print and the time is short I shall spend but very little time in attempting to summarize them.

In the first paper on the objects of the course, by Mr. Burt, a practicing engineer, you have noted doubtless, the distinction he makes between art and science in design, and perhaps you have noted his conclusion in the following words: "The purpose of training is twofold: (*a*) To store in the brain fundamental principles involved so that they are all ready

for reference. (*b*) To develop in the mind the powers of analysis, imagination, observation and logic so that the man may always be a student."

In the paper on "Subject Matter," by Professor Morris, a number of subjects are given as requirements for all civil engineering courses.

He has closed his paper with the details of the course given under his direction. The thought in bringing that in was to have something as a basis for discussion in regard to the details.

The committee would be gladly guided, as far as possible, by the membership of the Society as to whether it is practical to go into the detail in the sense of suggesting the particular subjects and the time that should be devoted to each.

In the last paper, "Training of Instructors," a number of the men with whom I have talked seem to think that the author has given more attention to the methods of teaching than to the training of instructors.

I feel Professor Smith had in mind certain methods which should be kept in view while developing the instructors. In talking with others a suggestion has been made that we should concentrate more upon how to train instructors than what to train them. That raises the question as to the amount of attention to be given to the study of the pedagogy and again opens a field for discussion.

A. H. FULLER, *Chairman,*
H. J. BURT,
C. T. MORRIS,
W. C. HUNTINGTON,
J. HAMMOND SMITH.

THE OBJECTS OF THE STRUCTURAL COURSES.

BY HENRY J. BURT,
Structural Engineer.

In this land, where education is a public function, the welfare of the commonwealth has first claim to consideration in the objects to be attained. The selfish interests of the student must be subordinate. If success be considered works accomplished rather than financial gain, the interest of the state and the interest of the student may be considered identical. The man should be trained to be a constructor, rather than a contractor; to be an economist of materials and labor rather than an economist of money; to conserve or make useful material resources rather than to consume them. These considerations are very general but should be in mind while specifying the training to be given in structural engineering.

Structural engineering is here considered as a part of the broad profession of civil engineering. Although its importance is growing rapidly in relation to the other branches of civil engineering, it has not yet become recognized as a distinct and separate profession. It follows that the structural courses must be a part of any complete curriculum of civil engineering. So far as the writer is informed, it is so recognized in all engineering colleges.

A broad definition of structural engineering makes it include all static structures whose designs are based on scientific principles and mathematical calculations. It involves the relation of load to strength, or stress to strain. There is practically no engineering design that does not involve the principles and calculations of structural engineering. This being so, it is evident that structural courses should form an important part in the study of civil engineering.

The proportion of the time which should be devoted to this subject is not easy to determine. Perhaps the minimum that should be considered is that required for the study of mechanics of materials, physical properties of materials, and

static stresses. At the other extreme would be the time required in curricula when electives are allowed and the student chooses subjects in structural design as his major courses.

The purpose of most students in engineering is to prepare for the practice of the profession as a means of livelihood. If left to their own guidance, they would likely select the subjects that promise the earliest results, *i. e.*, get them into remunerative employment at the earliest practicable date. This would lead to the study of the practice of engineering rather than the science on which that practice is based. In a few years the man would find that he was practising the art of engineering rather than the science; that he had become an artisan rather than a professional engineer.

Such a result as described above does not represent the best development of the student, so he must be guided into a better channel. He is entitled to such training that he can secure employment in engineering work, but he is not entitled, nor is it to his interest, to be so trained that he can secure an advanced position in practical work, but be lacking in the foundations from which he can build a professional rather than a craftsman's career.

In spite of good resolutions made at the time of graduation, this natural tendency is to neglect scientific studies. Very few young engineers after graduation give any time to advancing their knowledge of the theory of engineering, except when forced to do so by the problems confronting them. The less they know of scientific principles, the less likely they are to pursue the study of them after leaving school.

Recognizing the inability of the student to be his own guide during college days, and recognizing his tendency to neglect scientific study after graduation, it devolves on the teachers not only to prescribe the studies to be pursued during the college period, but to so train the student that he will continue in a progressive channel—all this to the end of securing the best ultimate result rather than early but limited success.

The foregoing discussion indicates the desired preponderance of training in the science of design. The purpose of this

training is twofold: (*a*) To store in the brain the fundamental principles involved so that they will always be ready for reference. This should be done as thoroughly as the implanting of numbers and letters is done in childhood. (*b*) To develop in the mind the powers of analysis, synthesis, observation, imagination and logic, so that the man will always be a student.

Some work in the art of design is necessary to illustrate the principles involved. It should be done more with this purpose than for the purpose of training a craftsman. The latter feature cannot be wholly disregarded, for the man must be equipped with enough practical skill to make him useful and enable him to start in the practice of his profession. But he must depend on his experience after leaving college to assemble in his storehouse the information, and to acquire by practice the skill that will ultimately make him a success in his profession.

SUBJECT MATTER.

BY C. T. MORRIS,

Professor of Structural Engineering, The Ohio State University.

In the opinion of the writer, the major portion of the work in a civil engineering course should be of a fundamental character and required of all civil engineering students.

As a person grows older, the necessity for a broad training in cultural subjects as well as the sciences impresses itself upon one. It should be the purpose of a college course to prepare one to meet the responsibilities of life and the business world, and to make, above all, good citizens who can take places of responsibility and leadership in their communities.

In the usual four-year course there remains little time for specialization after the necessary fundamental sciences have been taken, and it is the opinion of the writer that the great majority of college students in their third and fourth years are not mature enough to intelligently select the special

branch of civil engineering into which it is best for them to enter. In fact the great majority of graduates embrace the most promising opportunity which presents itself after graduation and usually remain in the special line upon which they first enter. This fact makes it desirable that all should have the foundation upon which may be based a career in either municipal, railway or structural engineering.

Some selection of studies should be allowed in the fourth year of the course, but probably not to exceed 8 to 12 credit hours.

The fundamentals required of all civil engineering students should include the following:

Language, including English,
Mathematics through the calculus,
Chemistry,
Physics,
Engineering drawing, including descriptive geometry,
Surveying—land, railroad, and topographic,
Geology,
Mechanics—statics, strength of materials, kinetics and hydraulics,
Materials of engineering, including testing of materials,
Steam, hydraulic and electric power, general course,
Astronomy and geodesy,
Sanitary engineering and water supply, general course,
Timber construction,
Roads and pavements,
Stresses and structural design, general course,
Concrete and reinforced concrete,
Masonry construction,
Economics of engineering,
Contracts and specifications.

After these courses have been given the necessary space in a four-year course, it is seen that very little time remains for specialization, not more than 8 to 12 hours at the most. In these 8 to 12 hours, the student should be allowed to elect any one of several groups of studies along the lines of municipal

and sanitary engineering, railroad engineering, or structural engineering.

The structural engineering group should include courses in advanced bridge design, tall building construction, and the principles governing the calculation of statically indeterminate stresses and secondary stresses.

Even if more time than is here indicated is devoted to structural engineering, an effort should *not* be made to turn out finished draftsmen or detailers. The technique of draftsmanship and detailing can be acquired in a few months in any structural drafting room, and if the fundamentals of the subject have been mastered in college the ultimate value of the man will be greatly increased.

Neatness and accuracy, in English, arithmetic, and drawing should be insisted upon during the entire course. Frequent individual problems should be assigned and the solutions required handed in in ink. These should be carefully checked over and errors indicated, as half of the instructional value of the problem is lost if the work is not done independently and the mistakes found and corrected.

Inspection trips to structures in the vicinity should be made and examples of good and bad design pointed out. In this way, as in no other, can methods of construction be taught. The average student has very little conception of these matters and even photographs will not adequately serve. Also if possible, an inspection trip should be made to a plant where structural steel work is fabricated, in order to give the student a general idea of the methods of manufacture.

And finally, the fact should be impressed upon the student that when he graduates he has only completed the first stage of his education. His study and investigation along his chosen line should continue if he expects to keep pace with, and take advantage of the opportunities for advancement which will be constantly offered to those qualified for them.

A brief outline of the structural work given in the civil engineering course at the Ohio State University will serve to illustrate the content of the subjects listed above.

Stresses and Structural Design is required of all civil engineering students except those specializing in municipal and sanitary work. Four recitations or lectures per week for two semesters are required.

In teaching this course an effort is made to review briefly the principles of mechanics because it has been found that no matter how thorough the training in mechanics has been, the students require some review in order to intelligently grasp the application to structural design. After this brief review of the principles of statics, the graphic and algebraic solution of the stresses in roof and bridge trusses is taken up, followed by the method of coefficients for trusses with parallel chords. The analysis of the stresses in trusses with subpanels and with curved chords is also taken up. Then the wheel load analysis is given for trusses with parallel chords and the methods of calculating stresses up to wind and centrifugal force for bridges with curved track are given. This finishes the course in stresses but it is seldom that all of it can be completed before the end of the first semester and usually part of it has to be taken up in the first part of the senior year.

The work in bridge design commences with the design of beams and plate girders, followed by the design of the main members of truss bridges. Then the design of the details is taken up, commencing with riveting, net sections, pins, etc.

Throughout the course individual problems are given and required to be handed in in ink. Considerable time has been required in developing these individual class problems but I believe that the results fully justify the effort. No matter how conscientious the student may be, if all of the members of the class are working with the same problem, a comparison of results is bound to occur and some of the men will not obtain the benefit that is obtained by the solution of individual problems.

We do not spend a great deal of time in the drafting room in this course as I believe that with the thorough training in engineering drawing which our students receive in the engineering drawing department they can take up the technique

of structural drafting in the drafting room in a very short time and that their time in college is much more profitably spent in getting the fundamentals of design. The records of the graduates of this department I believe will bear out this view.

For those specializing in municipal and sanitary engineering a three-hour course for one semester is given covering both stresses and design of simple roof trusses.

Concrete and Reinforced Concrete is required of all civil engineers and is given in two parts, a two-hour laboratory course in testing cements, aggregates and concrete mixtures, and a three-hour recitation and lecture course in reinforced-concrete design. In this latter course the methods of design of beams, slabs, tee beams, columns, etc., are taken up and a full-size reinforced-concrete beam is tested and extensometer measurements made so that the relations between the actual deformations and the theoretical are determined.

A thorough course in *Masonry Construction* is given to all civil engineers covering two semesters, four hours and three hours per week respectively. In this course is taken up a thorough study of the materials and the design of piers, abutments, foundations, retaining walls and similar masonry structures.

Two courses are offered which are optional and are taken by those wishing to specialize in structural work. These are *Advanced Bridge Design* and *Tall Buildings.*

The course in *Advanced Bridges* takes up the subject of cantilevers, swing bridges and arches. In this course an effort is made to give the fundamentals regarding the calculation of stresses in these types of bridges and also some work in design. Work in both steel and reinforced concrete arches is taken up.

The course in *Tall Buildings* commences with the design of the floor construction including the various types of reinforced-concrete and tile floors and then proceeds to the design of the floor beams and floor girders. After this follows the design of columns for (both central and eccentric loading) the wind bracing (both with and without diagonals), and finally the footings and foundations.

TRAINING OF INSTRUCTORS IN STRUCTURAL ENGINEERING.

BY J. HAMMOND SMITH,

Professor of Civil Engineering, University of Pittsburgh.

The essential qualifications of a good teacher may be summed up under the following headings.

1. He must have a commanding bearing in relation to his classes.
2. He must know his subjects thoroughly.
3. He must be able to inspire and lead his students.
4. He must be able to judge his students fairly.
5. He must maintain a congenial relation in general with his associates on the teaching staff.

The teacher must be in full command in his classroom, at all sessions, whether they be lectures, recitations or design periods. The first requisite of any instructor is to maintain proper decorum. This may be often done tactfully—by substituting recitations and quizzes for what would ordinarily be explanatory lectures. If lectures do not receive proper attention from the class as exhibited by decorum and attention, they should be discontinued or given less frequently or reduced in scope, and a method more compelling laid down before the student; viz., recitations consisting of blackboard work with explanations before the class, or oral and written quizzes. The efforts of many lecturers are largely wasted because many minds in the class are wandering from the subject being presented. Even the best students will tire under a continuous lecture system. The author prefers to use a system of combined lectures, recitations and quizzes, and doubtless there are many others in the engineering teachers profession who are using practically the same methods. First the instructor should assign the lesson for the following period with any brief explanatory remarks which may seem necessary. Then he should explain clearly, and without too much haste, the essential points in the day's lesson. If one-

hour periods are used he may lecture for fifteen minutes, or if the scope of the subject for the hour is unusually large or complicated he may take the whole period and omit lecturing in the following period. He should review the subject in the text shortly before presenting it to his students, so that he can explain the essential points in such a way as to augment the students' book knowledge of the subject, instead of delivering the subject in a different manner or order and thus confusing the student. Usually the class should be encouraged to ask questions at the end of the instructor's lecture. These questions are generally a very good measure of the students' knowledge of the subject, although most students are not cognizant of this means of bringing them out in their true stature. It is highly important that the instructor resort to good diagrams or illustrations as an aid in making his lectures clear. If blackboard illustrations are used, they should be prepared, if possible, before the lecture. Great caution should be exercised by the lecturer in guarding against confusion, by presenting the lectures in the wrong order or by broadening the subject unduly, or reaching over into the following lesson unintentionally. This caution also applies when answering students' questions, as many students will ask questions beyond the lesson or not vitally related to the subject. Many teachers, just the same as many writers, do not appreciate the fact that a superfluity of words only serves to hide the basic essentials of the subject.

Following the lecture part of the period, a part of the class should be assigned problems to be worked out and later explained at the blackboard. The remaining part of the class should be given one general problem to be worked on paper at their seats, and the instructor should circulate among these students to make sure that they are using the proper methods of solution. It is a wise plan to use individual and original problems very frequently in addition to the problems found in the text.

The preliminary calculations in elementary design may be carried on to the best advantage by lectures with blackboard

work to direct and check the students, who are at their seats or tables with notebooks and references. The calculations should be sufficiently full to permit the student to begin drafting with practically all required data in his notebook. If possible the preliminary design should just precede the work on the drawing board. Brief lectures may be interspersed through the drafting periods as would seem necessary to clear up points which were not definitely decided in the preliminary design.

An instructor in structural engineering should be a man who has had considerable experience in structural plants in addition to his course in engineering. He should be highly interested in his subject and constantly progressing, by means of laboratory research work and outside practice in the profession.

The heads of the various departments should keep in close touch with their instructors, especially with their new instructors. The latter should receive careful instruction on methods of teaching and scope of work to be covered.

The instructor should use tact and judgment in gaining the confidence of his students. He can then encourage greater effort by requiring of the student all he can accomplish, but no more. If a student is overloaded he is likely to lose confidence in himself, because he is unable to work out anything to his satisfaction. And it is satisfaction which promotes interest.

REPORT OF COMMITTEE NO. 17—ELECTRICAL ENGINEERING.

Your Committee on Electrical Engineering feels that a brief survey of the present status and future plans of the various institutions of the country, with respect to special preparation of electrical engineering students for military service, would be of most interest at the present time.

The changes in instruction in electrical engineering have therefore been investigated at twenty-six representative institutions throughout the country. In twenty of these, special courses have been administered during the second semester in radio communication. In most instances, equivalent credit has been granted for senior courses previously required for graduation. The general tendency seems to be to give credit in elective courses or for thesis. Several institutions insist that all, or a large portion of this credit, be confined to courses outside of the school of electrical engineering. Your committee calls your special attention to this, in view of the fact that these radio courses are highly specialized and theoretical in nature and tend, therefore, to increase unduly the amount of instruction in pure electrical engineering at the expense of culture and general electives which are very often given too little consideration in the education of an engineer.

Courses in radio communication, with the exception of code practice, have been pretty generally administered by the regular staff of instructors with the coöperation, in many instances of the department of physics. The code practice has been administered either by local telegraph operators or by students or assistants who have become expert in the code as amateurs in wireless telegraphy. From four to five hours per week have been devoted to the code practice in most institutions reporting on this feature of the course. In some cases

students were permitted to devote their own time to such work during hours when they were free, using as an incentive the fact that the Signal Corps recommends a proficiency of at least ten words per minute and preferably twenty words per minute for technically trained officers.

Although at the convention of the Society last year in Washington, plans of the various institutions seemed to indicate that a large degree of intensification and possible shortening of the training of electrical engineering were anticipated for the year, comparatively little has been put into effect in the institutions investigated. In ten schools out of the twenty-six such a policy has been adopted. In most cases this involves merely the elimination of holidays and vacations, resulting in closing the institution from one to four weeks early this spring. In most instances a very positive statement was recorded to the effect that no further attempt would be made to intensify or shorten the course during the forthcoming year. At four institutions only, a summer session is planned for the present junior class in electrical engineering, with the idea of graduating this class in January or February. Several schools report a consideration of such a possibility with the later abandonment of the idea resulting from faculty vote or adverse student sentiment. With the expressed policy of the War Department and the Navy, to the effect that students in engineering, anticipating military service, should complete their regular courses and with the provisions of the naval, signal and engineering reserves, your committee feels that the need for shortened and intensified courses has been pretty generally eliminated.

The demands for technical graduates in the military service have reopened, in many instances, consideration of the desirability of continuing university training for all classes throughout the year on the four-term basis. At Purdue University and one or two other institutions, faculty committees are considering this possibility. So far as reported to the committee, however, the University of Washington is the only institution investigated where final decision has been

made in favor of the four-term plan. In many schools where either faculty, student body, or both, has defeated the plan for summer session for senior electrical engineers, this fact would seem to indicate that the summer session of a four-term schedule would be neither popular with, nor largely attended by engineering students. The personnel of both student body and faculty and hence the nature and quality of the work accomplished, would probably be quite different from that carried on during the other three terms of the year.

With regard to plans for the forthcoming year, many schools are arranging for a considerable amount of extra military drill, particularly in institutions where such training has not been administered in the past. In a few cases it is planned to teach radio courses throughout both semesters of the senior year rather than to concentrate this work in the second semester, as was generally the case during the past year.

The addition of new courses of special value during the war, has been recognized in most instances, to have a stabilizing effect upon the student body, thereby tending to hold the students to their regular work more successfully than during the second semester of 1917.

The difficulty in securing well qualified instructors, not only for courses in radio communication, but in electrical and other engineering instruction which was anticipated and emphasized at the 1917 convention, has resulted in a great handicap, particularly in the eastern institutions, during the past year. With the extensive provision being made by the War Department and the Navy for the continuation of technical studies by the students, it will be not only extremely unfortunate but suicidal to the successful operation and instruction of reserve engineers, if provision is not made during the summer for the further exemption or furlough of able instructors involved in the draft or in military service. It is to be hoped that the activities of the convention may bring about some concrete results to this end.

The attention of your committee has been directed to the

bulletin of the University of Wisconsin entitled "A Digest of the Relations Between the Electrical Units and of the Laws Underlying the Units," which has been prepared during the year by Professor Bennett of that institution. Under normal conditions this bulletin would prove a very interesting and valuable subject for analysis by the Committee on Electrical Engineering. It was felt, however, that the committee during the period of the war, should confine itself to the special problems in electrical engineering instruction resulting from the needs of the military service. The committee desires, however, to direct your attention to the bulletin in question for future study, although it feels that such a radical change in the fundamental units and methods of presentation of the electric and magnetic circuits must necessarily be considered as a problem akin to the adoption of the metric system in America. Although possibly a superior system in some respects, if adopted in the infancy of the study and use of the electric circuit, the difficulties involved in a change of system at the present time seem to the committee to greatly outweigh any slight advantage which might be gained thereby.

In conclusion it is hoped that the new Committee on Electrical Engineering for the forthcoming year will continue to study and report tendencies and changes in instruction brought about by military activities, for it is believed that in so doing it can be of utmost usefulness to the Society. We would suggest further that a report at the end of the first semester be published in the bulletin of the Society, in order that those interested in electrical engineering instruction may be thoroughly posted at that time regarding the means adopted by other institutions to meet the current needs of electrical engineering training for military service.

C. F. HARDING, *Chairman,*
O. J. FERGUSON,
D. C. JACKSON,
H. E. DYCHE,
F. T. DARGAN,
Committee.

Discussion.

To the Society for the Promotion of Engineering Education.

In the July issue of *Electrical World,* we the undersigned read the articles on "The Special Preparation of Electrical Engineering Students for Military Service" as given by the Committee on Electrical Engineering at the recent meeting of the Society for the Promotion of Engineering Education at Evanston, Ill. This, to our minds, was very interesting and in a way strikes a note of humor, as we are both graduate electrical engineers from two well-known institutions.

Private —— is a graduate of —— and has been in the service of his country four months. Private ——, a graduate of ——, has served nine months. Both of us were assigned to the Ordnance Corps and during our assignments never at any time have had opportunity to apply our engineering training. Recently we were assigned to the Chemical Warfare Service, U. S. A., and stationed at ——. Here too we thought that we would have an opportunity to apply ourselves but we have been placed in the boiler room of power plant No. — serving as coal passers. The men over us are all men of little or no education and even though the work is degrading we can not help but see some humor in it.

The crying need all over the world, both in civilian and army circles, is for technically trained men. The Engineering Corps alone could absorb every engineer now in the service. Schools and colleges are doing their best to establish war courses for engineering students but why are they not used once they enter the service? Applications for transfers to Engineering Units will not be accepted and still the men continue to waste their time and training.

COMMITTEE ON ELECTRICAL ENGINEERING.

Private —— has completed his course at the Westinghouse Electric Company and was employed until four months ago by the New York and Queens E. L. and P. Co. Private ——

has been connected with Henry L. Doherty and Company of New York.

We do not cite our cases as a concrete example of how engineers are not put where they could be of best service, but we can mention more cases we have come across in the service; especially while throwing our time away in southern camps. The committee may see theoretically an advantage in establishing these military courses, but should they trace the graduates after entering the service they will find that results are different.

Now in closing we wish to state that this is a personal letter from two soldiers to a committee which is given national recognition and should our names be divulged it may lead to our court-martial, but even at that we could stand it. Nothing could be worse than a coal passer's place in a boiler room, but we hope that our names will not be given away.

Trusting that this letter will be of some little value to and other committees, we remain,

Respectfully yours,

PRIVATE .....

PRIVATE .....

REPORT OF THE COMMITTEE ON STANDARDIZATION OF TECHNICAL NOMENCLATURE.

BY J. T. FAIG, Chairman.

Mr. Chairman: Due to the lateness of the hour I shall ask leave to print the report later and shall present only a part of the work of the Committee on Technical Nomenclature.

The committee took up the matter of symbols for the reason that it was requested to do so at two annual meetings.

Symbols for mechanics were considered first, because this subject is fundamental to many divisions of engineering.

Letters were sent to professors of mechanics and hydraulics who are members of the Society, and to some other persons. Each letter requested the recipient to suggest the symbols that he thought should be standards in mechanics and hydraulics. Eighteen replies were received. Thirteen replies were accompanied by lists of symbols. Four replies favored a standard list, but submitted no specific suggestions. One reply opposed standardization of symbols by the committee.

These symbols were charted, tabulated and printed in the BULLETIN, S. P. E. E., for December, 1917, under the title, "Symbols for Mechanics and Hydraulics." Reprints of this paper are in your hands. For instance, angular acceleration appeared on six lists, the Greek letter alpha being given as the symbol on all six lists. Acceleration due to gravity appeared on eleven lists and on each list the symbol "g" was given. The table on pages 149, 150 and 151 present the evidence to you.

The list was mimeographed and sent to about fifty professors, editors and engineers. Accompanying each mimeographed copy was a letter which stated the method followed in making the list and which requested criticisms.

The committee also received suggestions from representatives of some of the national engineering societies and from a number of prominent publishers of engineering books.

While the number of names is not large, the list is fairly representative. The editors approved heartily of the idea of a standard list and objected to all Greek letters except π; otherwise they did not care particularly what symbols were selected. This attitude was also that of most of the practicing engineers.

I wish to make one correction and two changes in this list. On page 153 you will notice the item "Deflection of Beam," which you will please change to lower case "y." About one half way down the page you will see that horsepower has the symbol Hp. I wish that stricken out altogether. Near the bottom of the list the concept "angular velocity" has the letter "w" for the symbol. I wish that stricken out altogether. As you know, "omega" is the sign usually used at the present time.

You will also notice that no symbol is given for "angular acceleration" on page 152. The term generally used is the Greek letter "alpha"; that is the symbol I prefer at present. However, there is considerable objection on the part of the publishers of magazines to the use of Greek symbols.

Symbols for Mechanics and Hydraulics.

The following submitted lists:

O. H. Basquin,	Northwestern University;
J. E. Boyd,	Ohio State University;
G. R. Chatburn,	University of Nebraska;
I. P. Church,	Cornell University;
R. L. Daugherty,	Rensselaer Polytechnic Institute;
Wm. Kent,	Montclair, N. J.;
A. L. Jenkins,	University of Cincinnati;
E. R. Maurer,	University of Wisconsin;
John McGowan,	University of Toronto;
E. K. Ruth,	University of Cincinnati;

S. E. Slocum, University of Cincinnati;
G. S. Thompson, Rensselaer Polytechnic Institute;
E. H. Wood, Cornell University.

The suggestions made in an article in the *Engineering News-Record* of April 12, 1917, by R. Fleming, of the American Bridge Company, were also tabulated.

The symbols suggested were charted on a large sheet and tabulated, with the result given in the following list:

SUMMARY OF THE SUGGESTIONS RECEIVED, OMITTING THOSE CONCEPTS OR SYMBOLS THAT WERE SUGGESTED IN ONE LIST ONLY.

Concept.	Symbol.	Number of Lists Suggesting It.
Acceleration, angular	a	6
Acceleration due to gravity	g	11
Acceleration, linear	a	6
Area	A	8
Breadth	b	7
Center of rotation	O	3
Coefficient of friction	μ	4
	f	2
Coefficient of roughness, Kutter	n	2
Coefficients	C, c	2
Compressive stress	C	2
Constant	K	3
	c	2
Deflection of beam	y	3
	D, Δ	2
Deformation or elongation, unit	ϵ	3
	δ	2
Depth	d	9
Diameter	d	9
Diameter of shaft	D	4
Distance	s	3
	d	2
Distance of extreme fiber from neutral axis	c	5
Eccentricity of application of load	e	3
Efficiency hydrau., mech., vol.)	e_h, e_m, e_v	2
Energy	E	2
Energy, kinetic	$K.E.$	2

Elongation, unit deformation or	ϵ	3
	δ	2
Force	F	8
	P	3
Force, moment of	M	4
Forces, or stresses, tensile	T	2
Force or load, total	W	5
Force or load, unit	w	7
	p	5
Friction, coef. of	μ	4
	f	2
Friction factor, hydraulic	f	5
Head	H, h	9
Height	H, h	9
Horsepower	$H.P.$	4
	$h.p.$	3
Hydraulic coefficient	c	5
Hydraulic friction factor	f	5
Hydraulic radius	r	4
	R	2
Hydraulic slope	s	6
Inertia, polar moment of	J	6
Inertia, rectangular moment of	I	13
Length	L, l	11
Load, eccentricity of application of	e	3
Load, total concentrated	P	6
Load, total force or	W	5
Load, unit force or	w	7
	p	5
Mass	M, m	6
Modulus of section	S	5
	Z	3
Modulus of elasticity, Young's	E	12
Moment, bending	M	8
Moment of force	M	4
Moment of inertia, polar	J	6
Moment of inertia, rectangular	I	13
Pressure, total	P	3
Quantity of liquid flowing	Q, q	7
	W	2
Radius	r	9
	R	4
Radius, hydraulic	r	4
	R	2

Radius of gyration	r	7
	k	5
Radius of shaft	R	4
Reactions	R	6
Resultant	R	5
Shear	S	3
	V	2
Span of beams	l	2
Stress, compressive	C	2
Stress in member, total	$S_{t,\,c,\,s}$	2
Stress, shearing	q	3
Stresses, tensile forces or	T	2
Stress, unit	$s_{t,\,c,\,s}$	3
	f	3
	p	2
Tensile forces or stresses	T	2
Thickness of any plate	t	4
Time	t	6
Torque	T	9
Velocity, angular (rad./unit of time)	ω	7
Velocity, angular (rev./unit of time)	$r.p.m.$	3
	n	3
Velocity, linear	N	2
Volume	v	9
	V	4
Weight	W	7
	G	2
Young's modulus of elasticity	E	12

The foregoing list was mimeographed and sent to about 50 professors, editors and engineers. Accompanying each mimeographed copy was a letter which stated the method followed in making the list and which requested criticisms.

Following are the names of nineteen persons who sent replies that contained criticisms and suggestions:

L. P. Alford	Editor (New York)
F. E. Ayer	Professor (Akron)
O. H. Basquin	Professor (Northwestern)
I. P. Church	Professor (Cornell)
R. L. Daugherty	Professor (Rensselaer)
A. L. Jenkins	Professor (Cincinnati)

Wm. Kent	Engineer (Montclair, N. J.)
A. B. McDaniel	Professor (Union College)
W. T. Magruder	Professor (Ohio State)
R. C. Matthews	Professor (Tennessee)
H. F. Moore	Professor (Illinois)
R. E. Plimpton	Editor (New York)
I. D. Potter	Professor (Kansas State)
A. L. Rice	Editor (Chicago)
N. C. Ross	Engineer (Cincinnati)
E. K. Ruth	Professor (Cincinnati)
R. F. Schuchardt	Engineer (Chicago)
S. M. Woodward	Engineer (Dayton)
R. B. Woodworth	Engineer (Pittsburgh, Pa.)

The committee also received suggestions from representatives of some of the national engineering societies and from a number of prominent publishers of engineering books.

While the number of names is not large, the list is fairly representative. The editors approved heartily of the idea of a standard list and objected to all Greek letters except π; otherwise they did not care particularly what symbols were selected. This attitude was also that of most of the practising engineers. Professors went into considerable detail and had strong preferences, but differed widely in their views. Those professors who had had the largest experience in writing and whose works are best known were favorable to the list. This was exactly contrary to the expectations of the committee.

A majority of the replies approved of a standard list based on the one submitted. In the light of the suggestions received the following list was made:

SYMBOLS SUGGESTED BY THE COMMITTEE.

Concept.	Symbol.
Acceleration, angular	A
Acceleration due to gravity	b
Acceleration, linear	O
Area	f
Breadth	C, K

Center of rotation	y
Coefficient of friction	d
Coefficients and constants	D
Deflection of beam	s
Depth	c
Diameter	e
Distance passed over	e_h, e_m, e_v
Distance of extreme fiber from neutral axis	F
Eccentricity of application of load	M
Efficiency (hydrau., mech., vol.)	f
Force	H
Force, moment of	h
Friction, coefficient of	H_p
Head	R_h
Height	J
Horsepower	I
Hydraulic radius	L
Inertia, polar moment of	e
Inertia, rectangular moment of	m
Length	Z
Load, eccentricity of application of	E
Mass	M
Modulus of section	J
Modulus of elasticity, Young's	I
Moment of force	Q
Moment of inertia, polar	r
Moment of inertia, rectangular	k
Quantity of liquid flowing	R
Radius	N
Radius of gyration	S
Reactions	t
Revolutions per unit of time	T
Stress, unit	w
Time	v
Torque	V
Velocity, angular	W
Velocity, linear	E
Volume	
Weight	
Young's modulus of elasticity	

Previous lists of symbols have not secured wide acceptance in this country. Some lists that have been proposed by prominent writers are familiar to very few engineers. It was ap-

parent that the chief difficulty to be overcome was not in the formation of a list of symbols, but in securing the acceptance of the list. The method followed by the committee has been to collect evidence regarding present practice and to present it. The list obtained by this method has disadvantages. The symbols composing it are not of the same order of importance. Many omissions, some of importance, occur. But it is believed to hold the nucleus of a standard list of symbols for this country, because it is composed of symbols that are in general use. Objection has been raised on the point that professors and writers, rather than engineers, have been consulted in its making. But it is the professors and writers who are largely responsible for the present chaotic situation with regard to symbols and it is only by concerted action of these that some order may be brought out of chaos. Engineers end editors appear willing to accept any list *that will be accepted generally*. The list is presented in the hope that it will assist in the evolution of a standard list. It is short. It contains no Greek letters. It is mnemonic to a considerable degree, though not by intention. It deals largely with mechanics because that branch is common to all the divisions of engineering. For those who are interested, the list is shown in slightly altered form on the following pages. Some letters, it will be observed, are unassigned.

LIST OF SYMBOLS SUGGESTED BY COMMITTEE.

A	Area.
a	Linear acceleration.
B	
b	Breadth.
C	Constant.
c	Distance of extreme fiber from neutral axis.
D	Diameter.
d	Depth.
E	Young's modulus of elasticity.
e	Eccentricity of application of load.
e_h, e_m, e_v	Efficiency (hydraulic, mechanical, volumetric).
F	Force.
f	Coefficient of friction.

G

g ..... Acceleration due to gravity.

H ..... Head.

H_p ..... Horsepower.

h ..... Height.

I ..... Rectangular moment of inertia.

J ..... Polar moment of inertia.

K ..... Coefficient, constant.

k ..... Radius of gyration.

L ..... Length.

M ..... Moment of force or sum of moments of forces.

m ..... Mass.

N ..... Revolutions per unit of time.

n

O ..... Center of rotation.

P ..... Concentrated load.

p

Q ..... Quantity of liquid flowing in pounds.

q

R ..... Reaction.

R_h ..... Hydraulic radius.

r ..... Radius.

S_t, S_c, S_s ..... Unit stress in tension, compression, shear.

s ..... Distance passed over.

T ..... Torque.

t ..... Time.

U

u

V ..... Volume.

v ..... Linear velocity.

W ..... Weight of a body or total weight.

w ..... Angular velocity.

X

x

Y

y ..... Deflection of beam.

Z ..... Modulus of section.

z

The members of the Committee on Technical Nomenclature, S. P. E. E., are John T. Faig, Chas. Warren Hunt, E. N. Raymond and W. D. Ennis.

Discussion.

J. R. Nelson: I would like to know what the objection is to Greek letters.

John T. Faig: The publishers of magazines object to them. This report, of course, is a composite of all the views we have received. I do not see how we can get away from some of the Greek letters. I, personally, am in favor of using "alpha" and "omega" for the concepts angular acceleration and angular velocity respectively.

W. T. Magruder: With reference to Mr. Faig's statement regarding horsepower, I cannot see where there should be any trouble with multiplication in that any more than in other terms; "h.p." is as much multiplication as "hp" without the period between the two letters. We don't use periods in kva and kw; why should we use them in hp? I object to this Society going on record as opposing all the other engineering societies, and more that the report of the committee be amended by making the symbol for horsepower to be "hp."

John F. Hayford: The motion before you is that hp not separated by a period shall be the symbol for horsepower. You mean in lower case, don't you, Mr. Magruder?

Professor Magruder: Yes sir, in lower case type.

President Faig: As I understand it the standardization list of the American Society of Electrical Engineers puts the period in between the two letters.

Professor Magruder: I think not. For what reason?

President Faig: I couldn't tell you.

Professor Magruder: Then, for consistency in the standardization list, the periods should be put between the letters kva and kw, making it k.v.a. and k.w. If you spell horsepower as one word, omit the period; if you spell it as two separate words, put the period in. It is just the same as if you say "black smith" instead of "blacksmith" and "wheel barrow" instead of "wheelbarrow."

President Faig: I don't want to be understood as support-

ing the list as it is. I am merely pointing out the fact as it exists.

Director Hayford: The question before you is now that the symbol for horsepower shall be hp without the period.

Is there any further discussion of the motion? Then we will call for a vote. Those in favor say "aye," opposed "no." The motion is carried.

Professor Magruder: Is it the idea to ask the Society to adopt the list and the explanation that goes with the list? There is a statement here that calls our attention to the fact that there are no Greek letters in the list, and I am wondering whether, if the Society adopts this report as it stands, we desire to commit ourselves to the principle that we do not approve of the use of Greek letters. If that is the intention, Mr. Chairman, I would move an amendment to the report to the effect that we withhold our approval upon the recommendation that we do not approve the use of Greek letters.

Director Hayford: If I understand the parliamentary status just now, we have no motion before us. The proposition was not necessarily to O.K. the report of the committee.

Dean Taylor: I move to commend the list as amended.

Director Hayford: The motion is to commend the list of symbols on pages 152 and 153 as amended by this change in the horsepower.

Professor Baker: Why do we not just commend a recommendation of the committee rather than the list?

Dean Taylor: We get around the Greek snag that way.

President Faig: I believe it would be better to commend as amended the list of symbols, and then it can be amended from time to time.

Director Hayford: You have a motion before you to commend the list as amended.

Professor Jacoby: Is it not better to use "approve" than "commend"?

Dean Taylor: I will accept that amendment.

Professor Magruder: The amendment is that this Society

asks the committee to insert the Greek letters usually used. It doesn't seem desirable that this Society should go on record as being opposed to the use of Greek letters and the Greek alphabet. Are we so densely ignorant that we don't know a few letters of the Greek alphabet and cannot learn them? The publishers are not complaining. Printers may complain, but not publishers. I move the amendment that the committee be requested to insert in the list of approved symbols the Greek letters in their usually used places and risk their usual meanings.

(Motion seconded and carried.)

Director Hayford: Now we come to the original motion that the list of symbols on pages 152 and 153 be approved as amended. Is that motion seconded?

(Motion to approve the list of symbols as amended seconded and carried.)

REPORT OF COMMITTEE NO. 21, MILITARY ENGINEERING.

The first conflicts between man and man were nothing more than the conflicts between two animals who used the weapons with which nature had endowed them. Physical or brute strength were the dominant characteristics, intelligence and skill were secondary, the prize of victory was existence and the cost of defeat was death.

As civilization developed and grew, physical strength became less and less a factor with the development of arms and appliances which put the small man on a par with the large, and gave the victory to the mentally rather than the physically great, so that to-day the mentally trained or educated is the superior to the moral, physically strong.

This has been called an engineer's war and the tremendous call for engineers has been well answered by our engineering schools.

A letter received from the Chief of Engineers of the United States Army indicates that the present courses are as a general thing well fitted for the service to be rendered in war.

The special education and training required has been outlined by the War Department in an official Bulletin from the Chief of Staff, Vol. I, No. 4, and in General Orders No. 49 from the War Department establishing the Reserve Officers' Training Corps. Copies may be obtained from Washington.

Course of training for engineers' units of the Senior Division is as follows:

1. Military Art.

Three hours a week (counting 14 units).

(*a*) Practical. Weight 10.

Physical drill (Manual of Physical Training—Koehler).

Infantry drill (U. S. Infantry Drill Regulations), to include the School of the Soldier, Squad, and Company, close and extended order.

Practical military engineering—laying out and constructing trenches, obstacles, and revetments (Part V, Engineer Field Manual, and 584–595, Infantry Drill Regulations). Use sand table when outdoor work is impracticable.

(*b*) Theoretical. Weight 4.

Military organization (Tables of Organization).

Service of Security (Field Service Regulations).

Personal hygiene (lectures).

Part V, Engineer Field Manual (including latest addendum); omit mining and demolitions.

2. Military Art.

Three hours a week (counting 14 units).

(*a*) Practical. Weight 10.

Physical drill (Manual of Physical Training—Koehler).

Infantry drill (U. S. Infantry Drill Regulations), to include School of Battalion and Ceremonies.

First-aid instruction.

Range and gallery practice.

Practical military engineering—military mining and demolitions (Part V, Engineer Field Manual).

(*b*) Theoretical. Weight 4.

Lectures on general military policy as shown by military history of United States and military obligations of citizenship.

Service of Information (Field Service Regulations).

United States Infantry Drill Regulations, to include School of Company.

Camp sanitation for small commands (lecture).

Part V, Engineer Field Manual—military mining and demolitions.

3. Military Art.

Three hours a week (counting 14 units).

(*a*) Practical. Weight 10.

Same as course 2 (*a*) except practical military engineering, which will consist of knots and lashings and improvised military bridges.

(*b*) Theoretical. Weight 4.

United States Infantry Drill Regulations—School of the Battalion.

Small-Arms Firing Regulations, paragraphs 1–134.

Part II, Engineer Field Manual—Bridges.

4. Military Art.

Three hours a week (counting 14 units).

(*a*) Practical. Weight 10.

Same as course 2 (*a*) except practical military engineering which will consist of building military bridges, including floating bridges and instruction in rowing when practicable.

(*b*) Theoretical. Weight 4.

Lectures on recent military history.

Field Service Regulations—patrolling, advance and rear guard and outpost, orders and messages, marches, and camps and camp expedients.

Ponton Manual.

5. Military Art.

Five hours a week (counting 24 units).

(*a*) Practical. Weight 13.

Duties consistent with rank as cadet officers, noncommissioned officers, and instructors in connection with the practical work and exercises of the student taking courses 1 (*a*) and 3 (*a*).

Military reconnaissance and sketching.

(*b*) Theoretical. Weight 11.

Review of Parts II and V, Engineer Field Manual.

Notes on Field Fortification (Army Field Engineer School).

Part I, Engineer Field Manual—Reconnaissance. Weight 8.

Company Administration—general principles (papers and returns). Weight 1.

Two lectures on the History of Military Engineering (Students to submit notes on lecture). Weight 2.

6. Military Art.

Five hours a week (counting 24 units).

(*a*) Practical. Weight 13.

Duties consistent with rank as cadet officers, noncommissioned officers, and instructors in connection with the practical work and exercises of the students taking courses 2 (*a*) and 4 (*a*).

Military reconnaissance and sketching.

(*b*) Theoretical. Weight 11.

Review of military mining and demolitions in Part V, Engineer Field Manual.

Review of Ponton Manual.

Field Service Regulations, paragraphs 354–410, 242–246, and appendix 2. Weight 8.

Elements of international law. Weight 2.

Property accountability and methods of obtaining property (Army Regulations). Weight 1.

7. Military Art.

Five hours a week (counting 24 units).

(*a*) Practical. Weight 13.

Duties consistent with rank as cadet officers, noncommissioned officers, and instructors in connection with the practical work and exercises of the students taking courses 1 (*a*) and 3 (*a*).

Military reconnaissance and sketching.

(*b*) Theoretical. Weight 11.

Field Service Regulations—Article V, Combat.

The use of engineer troops—Official Bulletin No. 4.

Map reading and map maneuvers.

Manual of Courts-Martial.

8. Military Art.

Five hours a week (counting 24 units).

(*a*) Practical. Weight 13.
Same as course 7 (*a*).
(*b*) Theoretical. Weight 11.
Organization and equipment of engineer troops.
Night illumination of battlefield.
Studies in minor tactics (School of the Line, 1915).
Lectures on military history and policy, based on Upton.

The schedule of training prescribes graded courses covering a period of four years, and instruction will be taken up as follows:

BASIC COURSE.

Freshman year, courses 1 and 2 (28 units).
Sophomore year, courses 3 and 4 (28 units).

ADVANCED COURSE.

Junior year, courses 5 and 6 (48 units).
Senior year, courses 7 and 8 (48 units).

COURSE OF TRAINING FOR JUNIOR DIVISION, TOTAL WEIGHT 22 UNITS.

1. Infantry drill regulations (practical and theoretical, to include definitions, general principles, combat and ceremonies).

School of the Soldier.....
School of the Squad.....
School of the Company...
School of the Battalion...
} In extended order, combat, and intrenchments.

2. Manual of Interior Guard Duty (practical and theoretical). Duties as sentries; general principles.

3. Physical drills: Calisthenics, bayonet exercises, and combat fencing.

4. Military hygiene: To include principles of personal hygiene, camp sanitation, first aid to the injured, etc.

5. Military policy: A few lectures when in last year at institution on the military policy of the United States and the military obligation of citizenship.

6. Small-arms firing regulations: Preliminary instruction in rifle firing; sighting position and pointing and aiming drill; indoor and range practice; due attention devoted to fire direction and control and, if possible, some collective fire.

7. Administration and organization: A few lectures on company administration and tables of organization.

8. Map reading: Instruction in reading a contoured map (in connection with 9).

9. Field service regulations: Patrolling advance and rear guards; outposts, by means of the sand table and small map maneuvers; messages and orderly work.

10. Marches and camps: Simple camping expedients.

11. Signaling: Semaphore and flag.

Owing to the wide range of the ages of students in this class of institutions, the majority being too young to follow intelligently a graded course such as is prescribed for the senior division, ony the subjects in which proficiency must be attained are laid down. It is impossible to set any fixed number of years for the accomplishment of this programme, and hence each institution should arrange its schedule of instruction so that the cadet upon graduation will be proficient in all of the above subjects.

Should the cadet enter a collegiate institution in which is organized a senior division of the Reserve Officers' Training Corps he will not have to repeat the theoretical work in any of the above subjects, but he will not be excused from any practical work. He will not, however, repeat any work in the school of the soldier or squad if the professor of military science and tactics judges him to be proficient in such schools.

The courses prescribed can be added to in case institutions so desire, but the minimum requirements quoted above must be completed upon graduation.

To those who sign the agreement to take these courses, the

Government makes a certain allowance in both uniform and subsistence.

For those in institutions close to the sea, similar work could probably be done for the Navy.

C. S. SPERRY, JR.,
J. N. BRIDGMAN,
C. J. TILDEN,
H. S. BOARDMAN,
L. S. RANDOLPH, *Chairman.*

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